# AGRICULTURAL ENGINEERING

Published monthly by the American Society of Agricultural Engineers

at the headquarters of the Society

54 North Avenue, Mount Clemens, Michigan, U. S. A.

Subscription price to non-members of the Society, $3.00 a year, 30 cents a copy; to the members of the Society, $2.00 a year, 20 cents a copy. Postage to Canada, 50 cents additional; to foreign countries, $1.00 additional. Entered as second-class matter, November 7, 1923 at the post office at Mt. Clemens, Michigan, under Act of August 24, 1912. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921. The title "Agricultural Engineering" is registered in the U. S. Patent Office.

F. A. WIRT, President — RAYMOND OLNEY, Secretary-Treasurer

Vol. 6 — JULY, 1925 — No. 7

## CONTENTS

EDITORIALS ..... 147
—Make A. S. A. E. a Vital Force
—Broadcasting

THE USE OF EARTH FOR WALL CONSTRUCTION ..... 148
By J. D. Long

RURAL ELECTRIC INVESTIGATION IN CALIFORNIA ..... 154
By Ben D. Moses

THE PRESIDENT'S ANNUAL ADDRESS ..... 158
By H. B. Walker

RESEARCH IN AGRICULTURAL ENGINEERING ..... 161
—The Fundamentals of Research
By Wm. L. De Baufre

AGRICULTURAL ENGINEERING DIGEST ..... 164

NEWS SECTION ..... 167

Statements of facts or opinions advanced in original articles, papers or discussions are not sponsored by the Society as a body. Original articles, papers, discussions and reports may be reprinted from this publication provided proper credit is given.

## The Object and Scope of A. S. A. E. Activities

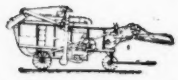
THE American Society of Agricultural Engineers was organized in December, 1907, at the University of Wisconsin by a group of instructors in agricultural engineering from several state agricultural colleges, who felt the need of an organization for the exchange of ideas and otherwise to promote the advancement of agricultural engineering. The object of the Society, as defined by the Constitution, is "to promote the art and science of engineering as applied to agriculture, the principal means of which shall be the holding of meetings for the presentation and discussion of professional papers and social intercourse, and the general dissemination of information by the publication and distribution of its papers, discussions, etc."

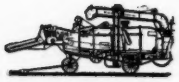
The membership of the Society represents all phases of agricultural engineering, including the educational, professional, industrial, and commercial fields.

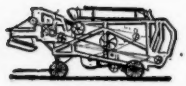
The scope of the Society's activities embraces both the technical and economic phases of the application of engineering to agriculture, and is comprehended in the following general headings:

(a) Farm Power and Operating Equipment—power, implements, machines, and related equipment.
(b) Farm Structures—buildings and other structures and related equipment.
(c) Farm Sanitation—water supply; sewage disposal; lighting, heating, and ventilating of farm buildings, and related equipment.
(d) Land Reclamation—drainage, irrigation, land clearing, etc., and related structures and equipment.
(e) Educational—teaching, extension, and research methods, etc., employed in the agricultural engineering field.

Member American Engineering Council

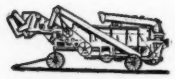

Wood Bros. Thresher Co.
"Individual"


Nichols & Shepard
"Red River Special"

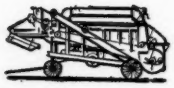

Frick Co.
Frick Model "A"

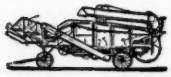
*Clark Machine Co.
"Williams"

W. G. Runkles Mchy. Co.
"Gill Peerless"

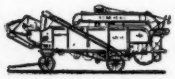

The Huber Mfg. Co.
"Supreme"

Climax Corporation
"Batavia"

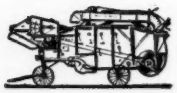

Doylestown Agricultural Works
"Doylestown"

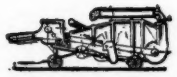

Minneapolis T. M. Co.
"Minneapolis"

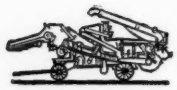
Ellis-Keystone
"Champion"


*J. I. Case T. M. Co.
"Case"

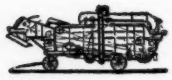
Illinois Thresher Co., Inc.
"Superior" Thresher and
"Scientific" Huller
Thresher

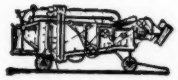

Sawyer-Massey Co., Ltd.
"Sawyer-Massey"

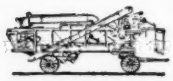

Messinger Mfg. Co.
"Ideal"


Pioneer Thresher Co.
"Pioneer"

Waterloo Mfg. Co., Ltd.
"Waterloo"


*A. D. Baker Co.
"Baker"


A. B. Farquhar Co., Ltd.
"Farquhar"


Keck-Gonnerman Co.

The Banting Mfg. Co.
"Greyhound"

THE engineers whose duty it was to specify the bearings that are used in these twenty threshers, specified Hyatt roller bearings. Their knowledge of bearing design and their experience with ordinary types proved to their satisfaction that Hyatt bearings alone possessed the features demanded by their standards of quality.

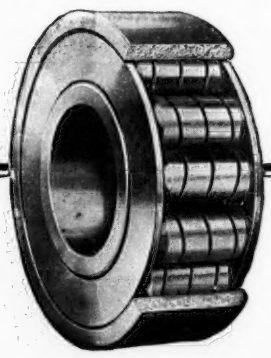
This list represents by far the majority of all threshers built and the Hyatt Roller Bearing Company is proud to have their product identified with these leaders in the thresher field.

*Optional Equipment

HYATT ROLLER BEARING COMPANY

NEWARK DETROIT CHICAGO SAN FRANCISCO
Pittsburgh Cleveland Worcester Philadelphia Milwaukee Charlotte

HYATT
ROLLER BEARINGS



# AGRICULTURAL ENGINEERING

The Journal of Engineering as Applied to Agriculture

RAYMOND OLNEY, Editor

Vol. 6 JULY, 1925 No. 7


## EDITORIALS

### Make A. S. A. E. a Vital Force

TO RENDER the fullest service to the farming industry must be the ideal of the American Society of Agricultural Engineers. This can be accomplished by helping to solve the vital problems of agriculture, which determine its success—social and economic. For the solution of these problems there can scarcely be any more potent factor than the well-trained agricultural engineer. To this end the A. S. A. E. can contribute by fostering:

1 — Better training of agricultural engineers.
2 — Raising the standard of qualifications for those aspiring to become agricultural engineers.
3 — Collecting and disseminating technical information for the use of agricultural engineers.
4 — Maintaining a standard of excellence and ethics for improving the calibre of agricultural engineers.
5 — Selling agricultural engineering service to those who need it.

**Training.** In endeavoring to employ competent agricultural engineers and executives I have found most candidates inadequately prepared. While it is essential that such a man should know how to plow, milk and do other regular farm work with his own hands, he should also be accustomed to using the exact thinking and systematic calculating which come from thorough engineering training. And besides being grounded in the fundamentals of agricultural production he also should be well schooled in farm economics and management, accounting and business law, and should have instilled into him the commercial viewpoint. This last essential can scarcely be imparted by instructors whose main experience has been academic, but might be done by lectures and instruction given by practicing agricultural engineers, farm managers and others in actual contact with commercial agriculture.

**Raising the Standard.** The A. S. A. E must and does have high requirements for membership. This is essential because the A. S. A. E. members must have the same professional standing as members of other engineering societies.

**Technical Information.** In collecting, standardizing and disseminating technical information. A. S. A. E. has already rendered great service, but there is still room for more of it.

**Code of Ethics.** Efforts to improve the standard of excellence and ethics as is done by other engineering societies will increase the confidence of the public in the members of the A. S. A. E.

**Selling Service.** There is no use in training agricultural engineers if a market for their services is not developed at the same time. All organizations and individuals employing agricultural engineers should be encouraged to employ only those complying with A. S. A. E. standards. The function of the agricultural colleges should be to train agricultural engineers but not to compete with their own graduates by offering free consulting service. In fact the U. S. Department of Agriculture and the agricultural colleges should respond to inquiries for service by sending out lists of properly qualified agricultural engineers.

Scarcely a more valuable work can be done by the A. S. A. E. than to help competent agricultural engineers to efficiently serve farmers, farmers' organizations, agricultural companies and state and federal governments. The most pressing problems of our agriculture today are economic, and it is the well-trained agricultural engineer with the practical business viewpoint (not forgetting the all-important human factor) who is going to contribute most directly to the solution of these problems.

S. F. MORSE

### Broadcasting

EVERY endeavor must be advertised. There are ways and ways. The right way is carefully thought out and planned. It may even be termed scientific because we develop a fine art with method in every step if we attack the problem in this way.

Have we as agricultural engineers allowed our knowledge of the technique of English, of advertising, of publicity, of good diction, to become stale? Are we depending upon the work putting itself over just because it is important while our rhetoric is going bad? Do we expect our readers to pick out the point in our written discourse even though we express ourselves poorly? Can we present our ideas forcefully, tactfully, boldly?

Every discourse must have a message. To deliver this message is the whole object of writing. First, then, we must decide what kind of publicity this particular message should have and then proceed with the preparation to suit the case. This classification may fall under heads such as these: news stories, reports, announcements, propaganda or informational articles.

We are fortunate if we have a good editorial staff who will rearrange and edit our articles, papers, reports, etc. Very naturally a college course in engineering gives only the minimum attention to English composition. All too many of us may have considered even this minimum as non-essential. Now we are coming to the place where we have real information which must be given to the public. To do this effectively requires a command of the English language.

We have an idea we wish to put over. How shall it be done? A news story is one of the most effective ways of reaching the popular mind. A news story to be real news must have the human touch. Then tell what John Jones has done. Bill Smith will copy Jones and try to go him one better. We can give just as definite information in this human interest story as we could in an informational article. Reports can be given the same personal touch. Mrs. Brown is proud to read her name in the report and all the neighborhood will read about her because they must keep up with the neighborhood gossip. And why not capitalize and improve our gossip? People must talk and they will talk. Even announcements may have much of personal interest added by telling some story of a speaker or other participant in the event being advertised. In this way we may cover our propaganda, for in the broad sense all such publicity is propaganda. The purely informational article has its place but it must be considered as least attractive to the public.

Now the real object of this editorial is to encourage broadcasting whether we do it by radio, newspaper, magazine, farm paper, bulletin, circular, personal letter or gossip.

E. R. GROSS

# The Use of Earth for Wall Construction

By J. D. Long

Jun. Mem. A. S. A. E. Assistant in Agricultural Engineering, University of California

NOTE: Considerable interest has been aroused in the possibilities of erecting structures with walls of natural earth used without admixture. In certain localities and states in this country and in England, France, and other countries, considerable use is made of this method of building, which dates back to primitive civilizations. Experimental projects on the subject are planned or in progress in the laboratories of the departments of agricultural engineering of the U. S. Department of Agriculture, Kansas State Agricultural College, North Dakota Agricultural College, University of Minnesota, and University of California. Opportunity will be afforded those attending the 1926 annual meeting of the American Society of Agricultural Engineers in California to visit some of the old Spanish missions and other adobe brick structures of the early settlers, as well as more modern examples of earth wall building.

THERE has been in the past few years an insistent demand in this country that building costs be lowered. A similar demand has been made in other countries, notably England, and with a housing shortage to aggravate the condition much attention has been directed in both countries at cheapening the cost of construction. Many innovations have been attempted, some with promise and some without. None, however, have had the general appeal or have aroused the widespread interest as has the proposal that natural earth be worked, without change, into walls.

Earth is found universally. It varies greatly in its physical constituents and properties, but if methods can be developed to incorporate the majority of soil types into satisfactory walls at a cost which will compare favorably with other masonry construction, the demand for such construction will be widespread.

Earth has been used by man for shelter from time immemorial. It is surprising, however, to note that comparatively little attention has been devoted to it or to working out better methods of using the natural product. Great skill and intelligence has been applied to the manufacture of building products from earths; the cement, clay tile and brick industries all reflect the natural adaptability of earth as a construction material. Natural economic laws, however, required that industry and industrial research produce a commercial product, hence earth wall building has been practiced in but a few isolated localities and even then has given way usually to the commercialized forms as soon as building became a commercialized trade. Natural earth building yields no profit except to the builder, and the trend of demand for construction material is naturally towards those which are brought most forcibly to the consumer's attention. Human psychology is perverse, but it pays to advertise!

It is not the purpose of the article to advocate that earth wall building supercede the modern commercialized masonry materials. The burned products are more durable and stronger than any natural earth construction can ever be. Neither is it the desire to recommend natural earth walls for all classes of construction. There are limitations to the use of any material, and those applying to natural earth are many indeed. But there are localities and classes of structures for which it appears that earth will serve as well, if not better, than other types of materials. Its limitations and the best methods of using it can only be determined by a fundamental study of the material and its properties. Such a study logically starts with a review of the use which has been made of the material in the past.

### Methods of Earth Wall Building

**Wattle and Daub.** One of the first materials used by primitive man for protecting himself from the elements was earth. When he first felt the necessity of shelter he probably battled with wild animals for the possession of natural caves, then dug caves as a shelter for himself, and finally ventured on to the open ground where he constructed huts of interwoven branches and reeds. He found that plastering these latter structures made them more livable, and so mud was used in filling up the spaces between the matwork. This style of construction is still used by primitive civilizations on certain parts of the earth and examples of it are said to have been found even in England within the last century.

**Sod.** From this most elementary "wattle and daub" construction other forms of earth wall building evolved. Perhaps the first step was to the sod house wherein strips of heavily matted sod were cut and piled in courses to form the wall. This construction was used freely on the homesteads of the middle western plains of our continent and examples exist to this day. To the homesteaders as to primitive man this construction served to fill a very great need in using materials readily at hand from which shelters could be erected at no great cost other than their own labor. Sod houses, however, have many apparent disadvantages as to length of life and protection against rodents. Our homesteaders turned to commercially produced materials such as lumber and bricks; primitive man cast about for better methods of building with earth.

**Cob.** The next distinct step was probably "cob." This method consists of working a suitable earth into a stiff mud and mixing in short pieces of grass or other vegetable matter for a binder. This mixture is then laid in place around the length of the wall in layers some 2

Fig. 1. (Left) An arch located in the famous public market place of Huancayo, Peru, on the Amazon slope of the Andes and supposed to have been erected in the latter part of the sixteenth century following the Spanish conquest. The arch is faced with cut stone, the main part of the wall being of rammed earth. A continuation of the wall may be seen on the immediate left of the picture. All of the buildings to be seen across the placa have walls of rammed earth, some whitewashed and some bare. The roofs are of tile or corrugated iron roofing. (Photo by courtesy of T. A. Wood.)

Fig. 2. (Right) Central boulevard of Tarma, Peru. Walls of all the main buildings in the town are of rammed earth approximately 18 inches thick; tile of corrugated iron is used as roofing. Whitewash is used on the walls with a three-foot skirting above the sidewalk of tar paint. Some foundations are of rock, others of rammed earth only. (Photo by courtesy of T. A. Wood.)

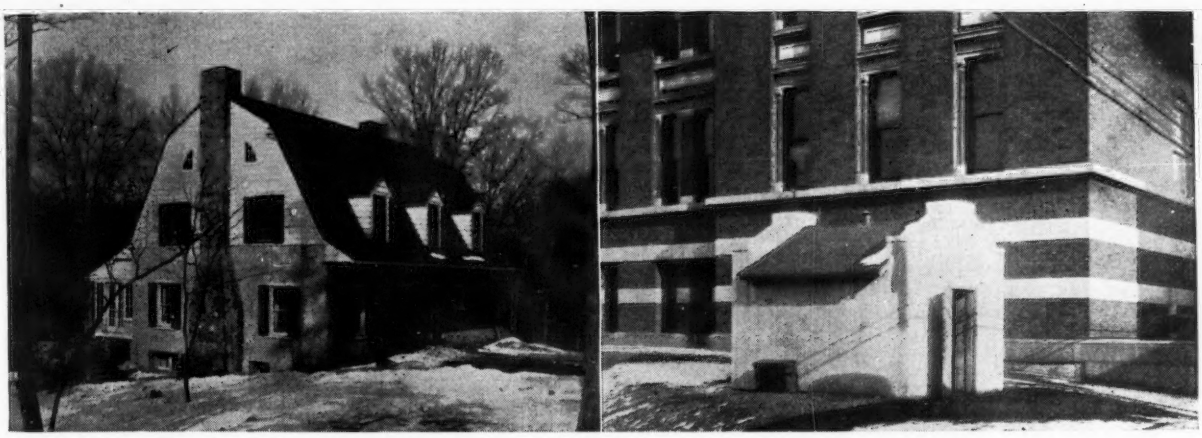


Fig. 3. (Left) Modern home erected in 1923 in Glen Echo, Maryland, by Dr. H. B. Humphrey of the U. S. Department of Agriculture. Lower walls are of rammed earth 18 inches thick, plastered and stuccoed directly on the earth surface. Photo by courtesy of Dr. H. B. Humphrey.)

Fig. 4. (Right) Small oil house of rammed earth walls erected in 1920 at David Tanken, Jr., School of Mechanical Trades, St. Louis, Thomas Crane Young, architect. (Photo by courtesy of Lewis Gustafson.)

feet high and 2 to 2½ feet thick. After being solidly compacted and roughly trimmed to an even thickness, it is allowed to dry when additional layers are placed on top of it to the height of the wall desired. Before it has become entirely dry and hardened the wall is trimmed plumb and to the desired thickness.

This type of construction is the first worthy of much consideration. It was made use of in varying forms in European countries for several centuries and is still popular in some rural districts of England. It is said to be used to the exclusion of other methods in certain of the North African countries bordering on the Mediterranean. From available literature it appears to have been the method largely used by the Indians of the southwestern United States and Central America before the Spaniards took possession. Some of the ancient structures existing in new Mexico and Arizona are said to still bear the imprint of the tools used to compact the mud in place and true the walls.

The only known modern construction of this type in the United States is in North Dakota. In the early days in this state it was common practice for the Mennonites and certain German and Russian emigrants to build houses of this type and sometimes of the mud formed into brick. Many of these houses are still occupied, others have been vacant and permitted to depreciate. The settlers built according to methods that had been familiar to them in their own country where such construction is commonly used for warmth. When asked why more of their homes were not built in this manner, one Russian farmer replied that it was too much work, that other people would laugh at them and that they were used to shivering in frame houses by this time anyway.

**Adobe Brick.** When the Spaniards captured the southwestern territory they taught the Indians the advantages of making the mud in blocks or bricks which they dried in the sun before incorporating in the wall. This permitted of more steady employment, that is, a small crew could work continuously at making the bricks desired without waiting the two or three weeks demanded for the layers of cob to dry out. The wall was more uniform throughout because of a predrying, and there were decided structural advantages in using small precast units in working about wall openings and other architectural features.

Where the Spaniards secured their knowledge of adobe brick, or "clay lump" as it is termed by some, is not known. The bible records the first industrial trouble as being related to the use of straw in bricks when the Israelites revolted under the tyranny of Pharaoh. Somers Clark, (1)* an architect of upper Egypt, states that what may have been some of the bricks made by the Israelites were so strong and well made that they are found as a foundation many courses deep beneath the ponderous stone work of ancient temples. Rich (2) writting in Chamber's Journal some 50 years ago describes the sun-burned bricks of ancient Birs Nimroud and the Majallibe as "looking like thick, clumsy clods of earth in which are seen broken reeds, or chopped straw, used for the obvious purpose of binding them." "Even though the individual bricks must, we may suppose, have been protected by the similar debris under which they lay," he writes, "it is surely not a little remarkable that they should be individually recognizable after fully 3000 years of exposure to the torrential rains of the Euphrates Valley."

Throughout California and other of the southwestern states are adobe structures which bear mute evidence to the stability of this form of building. What are said to be the three oldest churches in the United States are located in or near Sante Fe and Albuquerque, New Mexico. One is covered with nothing but a mud stucco and all are reported to be in an excellent state of preservation. Prof. G. W. Hendry, of the University of California, who recently made an investigation of the century old Spanish missions in California, states that in every case where the roof had been well preserved the wall below was intact except perhaps for falling stucco. Once the roof had been destroyed, however, the wall soon followed.

B. F. Clarke (3) states that in 1922 building permits calling for an expenditure of $1,690,340 were issued in Albuquerque, New Mexico. One-third of this sum was for residences and from statements obtained from contractors one-half of these were adobe. A goodly number of stores and business buildings were erected of adobe also.

In southern California there is at least one architect who deals only with adobe structures and keeps a steady crew of Mexicans to make the adobe brick. His work in this material has received the highest praise in the architectural press. A contractor dealing largely with this style of construction has departed from the time honored custom of making the bricks by hand and uses a clay tile machine which he has modified by making use of special dies. These dies form key-shaped grooves along the blocks to serve as plaster bonds. Another innovation in his work is the use of crude oil with which he coats the brick, after it has sun dried for from two to six weeks. By this means he secures an especially smooth, dense brick which has many advantages over the hand-made article. There are many brick yards near Los Angeles where hand-made sun-dried brick may be purchased and an increasing use is being made of these for all classes

*The figures in parenthesis indicate references in the bibliography at the end of this article.

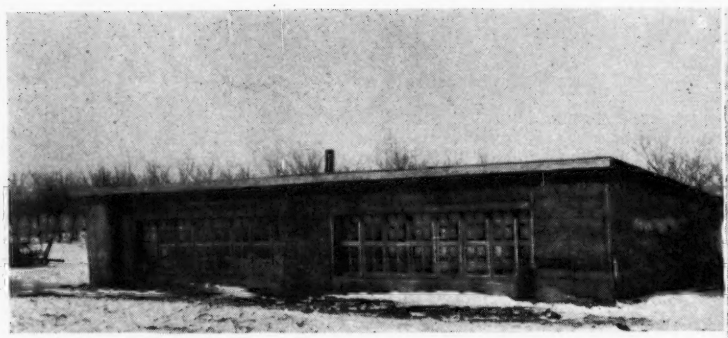


Fig. 5. (Left) A chicken house erected in 1924 on a North Dakota farm. The walls were plastered with cement plaster which loosened and came off on the front as shown. As this wall faces the south, this failure was probably due to a too rapid drying out of the plaster. This explanation is borne out by the fact that the plaster on the interior walls and other exterior walls remained intact. (Photo by courtesy of W. R. Page.)

Fig. 6. (Right) An apple storage house of rammed earth 13 by 13 feet at the base, walls 10 inches thick and 14 feet high. The tank and tower were there originally, the walls were rammed in place outside the tower members. The walls are painted with a cement wash. It was erected by C. E. Smith on his ranch at Templeton, California, in 1924. The forms which were used are shown in the foreground. (Photo by courtesy of J. Earl Coke.)

of structures except the largest apartment or commercial buildings.

**Poured Earth.** In the last few years there have been several structures made in California along lines similar to standard concrete work. Natural earth is mixed with water to a very plastic state and placed in forms constructed similar to those used for concrete. The earth is placed in six-inch layers and the forms moved up as the wall drys. No straw or other binder or reinforcement is used. In drying out the earth cracks but with the larger of these cracks filled with more mud and the sides plastered no more trouble is experienced.

This method has certain advantages in permitting the use of standard concrete machinery for mixing and in lessening the labor cost in that the earth is handled but once. No very old constructions of this type are known, but there appears to be no reason why under similar conditions it should not be comparable in length of life to the other systems of earth building.

**Rammed Earth.** Within the past five years interest has been aroused in this country in another type of construction which appears to be more widely applicable than the others systems and which has other desirable advantages suggested by its advocates. This type of construction is known by its French name, "pise' de terre," or in our English translation, "rammed earth." It consists of firmly compacting unadulterated soil between forms to the desired wall thickness. Specially selected earths between rather wide limitations may be used, the moisture content is just sufficient to permit the earth to ball up or compact readily and the process requires no special equipment other than form and rammers or tampers. The particular advantage of this type of construction is that the earth is used almost dry. There is no straw or other binder used or advocated by most of the workers in this method.

More has been written on the subject of pise' de terre than on any of the other systems of earth building. A reference is often quoted in modern writings from Pliny's "Natural History" relative to watch towers which had been erected in Spain by Hannibal (247—183 B. C.) and were still existant at the time Pliny wrote (23—79 A. D.) (4). In a "Communication" addressed to the English board of agriculture near the close of the eighteenth century, Mr. Holland, an architect, called attention to the suitability of pise' de terre to rural construction needs. (5). It was a method, he stated, which had been used by the ancients for rough walls, by the Italians for building the terraces which roofed their houses, by the Moors for all their walls and by the French and Spaniards for floors. He further stated that at the time of his writing (1797) the province of Lyons, France, appeared to be the only European district making extended use of the method.

The system appears to have spread to other localities as there is an account (6) of a large store house, 400 by 22 by 10 feet built in the barrack yard of the Emperor Alexander Grenadiers by Herr S. Sachs, a building inspector under the Prussian government, in 1822. Herr Sachs even wrote a book, entitled "Improved Pise Building", in which he stated, "There seems to be no doubt that this method of building will soon be generally adopted and will prevail above all in the rural districts for it has everything in its favor and there is nothing to be said against it."

Mr. J. D. Eshelby, an architect associated with the Brussels office of an English contracting firm, writes relative to the further history of the system as follows: "It is a fact that quite a large portion of the great wall of China is of rammed earth; recent travel has shown that in the hinterland of the Sahara, between the Mediterranean Sea and the upper waters of the Niger, in Central Africa, Abbysinia, Arabia, Mesopotamia and Persia, pise' de terre in slightly different forms is in common and extensive use, only the chiefs aspiring to other and more expensive forms of buildings.

"Travelers unfortunately see nothing peculiar in this fact and no one makes more than passing mention of it; the technical data is nil. One fact remains, the use of pise' in one form or another is much more prevalent in semi-civilization than was suspected. Its more general use is worth advocating.

"In the past, insofar as I know, with the important exception of this large section from France, extending from Rheims to well below Lyons, where it is and always has been largely used as a building medium, the use of pise' has been confined to the meanest of rural dwellings. In the Lyonesse, however, where the attention of builders has been drawn to its use, quite large country mansions and other buildings of importance exist, some of a certain antiquity, others modern."

Prof. J. W. Gilmore, of the University of California, tells of his experiences of some twenty years ago in the interior of China. The majority of the houses in the locality in which he worked, he states, were of rammed earth construction. For the main part they were poorly erected and being without foundations or other protection were so badly eroded at the base that the walls required props to hold them upright.

Mr. T. A. Wood who has just returned to the University of California following several years stay in Peru, Bolivia, Chili and Ecuador, relates many interesting facts regard-

ing the structures of earth still standing in sections of those countries which date back to the Spanish conquest in the sixteenth century.

Mining companies in these countries make extended use of rammed earth construction in housing their employees, the earth work being done by native laborers skilled in the practice. Houses of similar construction and uncertain age were found on the east side of the mountains in the jungle at the head of the Amazon river where they stood despite the torrential rains of that section. At elevations of 4000 feet where the precipitation is over 100 inches a year earth walls are used almost exclusively.

In Johannesburg, South Africa, the Pise' de Terre Construction Company does contract work in this material. An interesting section of a letter from Mr. E. T. Baines of this company states, "We have found from experience that a foundation of pise' is equally good to one of brick or stone. Such a foundation should be rammed into a two-foot trench some six inches wider than the walls with a dampproof course at the top at ground level. These are used even in districts receiving as high as 100 inches of rainfall per annum; so long as water is kept from running directly against the base of the walls it has no more detrimental effect on pise' than brick work. The capillary attraction in walls which are built straight on the ground without even a dampproof course, never exceeds a foot and there is no sign of disintegration of the wall which dries out as strong as before."

In the United States rammed earth appears to have had a very limited use. There are rumors to the effect that the first house built in this country, the one at St. Augustine, Florida, was built of pise' de terre. Within just the last few years an earthen-walled house has been discovered in Washington, D. C., which was erected in 1773. It was not until the house was to be demolished that the nature of its construction was discovered and then the walls were found to be so sound that the house was restored and remodeled. The first authenticated account, however, is credited to a Mr. S. W. Johnson of New Brunswick, New Jersey, who demonstrated the practicability of earth building by erecting a pise' house and then publishing a treatise on the subject in his "Rural Economy" in 1809.

Following this period no consideration appears to have been given to the method until Mr. Thomas Crane Young, an architect of St. Louis, became interested in the subject from English references and constructed a small storage house of the material on the grounds of the David Rankin, Jr., School of Mechanical Trades in that city in 1920. (7) Dr. H. B. Humphrey, of the U. S. Department of Agriculture, Washington, D. C., erected a home of rammed earth in a suburb of that city in 1923. This latter construction has received wide publicity in the press and is largely responsible for the very great interest which has been aroused in the subject in this country. (8)

Mr. Karl J. Ellington, a Swedish engineer experienced in the use of pise' in his native land, has been doing some work and reports that through his writings (9) structures have been built in California, Indiana, Illinois, Minnesota, and Canada.

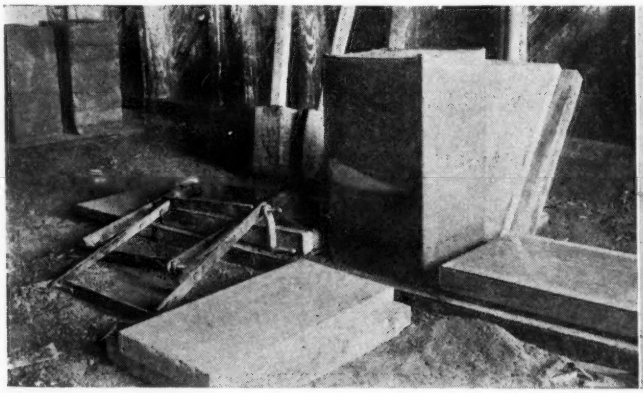
Several agricultural colleges and other institutions are undertaking projects in this style of construction. Tests are in progress at the University of California, in the division of agricultural engineering; a small experimental house is under construction at the Kansas State Agricultural College by the agricultural engineering department; a similar department of the North Dakota Agricultural College is cooperating with the agricultural development bureau of the Great Northern Railroad in constructing a small experimental and demonstration structure.

### Experimental Development

It is not the province of this paper to attempt a complete discussion of the fundamentals and practices incident to each type of construction. There are fundamental differences between the various methods which will undoubtedly result in the adoption of that method which is best suited to the local conditions.

The greater interest which has been aroused in rammed earth over any of the other systems is undoubtedly due in part to the fact that it is more capable of universal application. The use of the soil in a dry state not only obviates the handling of the messy material used in wetter mixtures and reduces the time necessary for the walls to dry out, thus saving considerable time during construction, but permits the use of a wider range of soils. When less moisture is used soils of a higher clay content can be used with less contraction and cracking on drying. The method may also prove more feasible for climates less dry than those in our southwestern states where the methods using more water have proven so popular.

**Suitability of Soils.** The suitability of various soils and the possibilities in mixing two or more unsatisfactory earths to form a suitable mixture are determinations which will require much experimental work. The governing of the action of those smallest of soil particles—the soil colloids—about which even the soil physicists have as yet secured so meager data, is a phase which will prove all important in any technical understanding of the subject. (10), (11) The floculation by chemical means of the colloids, resulting in partial destruction of their properties, in earths which would otherwise prove too high in such content, will prove a field to hold the interest of the investigator. (12) The methods of retarding the drying out of the outer layers of earth walls to prevent checking and cracking is of importance in securing the full strength of



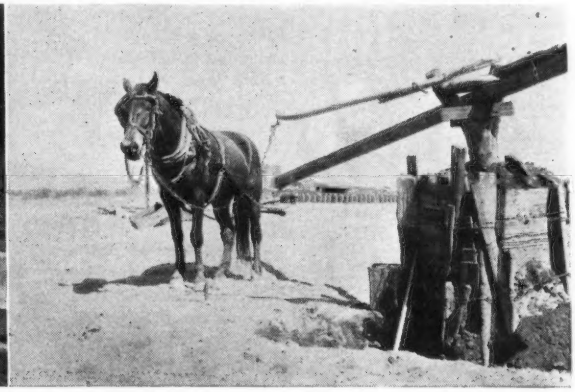


Fig. 7. (Left) The preliminary experiments conducted at the University of California consisted of ramming several test blocks of different soils. The one shown ready to take from the forms was formed of a fine sandy loam containing 15 per cent clay and averaging 12.5 per cent moisture. The marbling effect is caused by a difference in moisture content. Some of the rammers used are shown

Fig. 9. (Right) A homemade labor-saving mixer used by a California farmer in mixing the straw and dirt with water to form into brick. Rows of brick standing on edge to dry out evenly on both sides may be seen in the background. (Photo by courtesy of M. M. Winslow.)

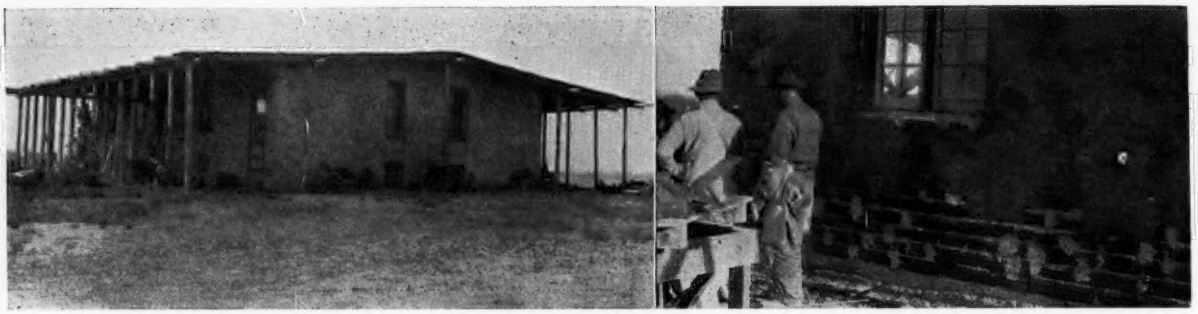


Fig. 8. (Left) A ranch house of poured construction erected on the Liberty Ranch, Oroville, California, in 1922. The walls are 18 inches thick plastered inside and out with two coats of cement plaster with a finishing coat of lime plaster inside. There is no foundation. The roof has a wide overhang on all four sides. The service rooms are set 4 feet below the earth's surface for coolness; the style of architecture and the rough finished walls are all eminently in keeping with the treeless foothill region in which it is located

Fig. 10. (Right) An adobe block wall on a concrete foundation, the block set in lime mortar. The blocks were formed in a clay tile machine which formed a groove for a plaster band along each block. This picture was taken on the R. H. Baker Ranch, Saugus, California. (Photo by courtesy of J. P. Fairbank.)

the material. This is exactly analogous to the proper curing of concrete.

**Equipment.** The development of equipment which may be best suited for the varying requirements is a phase of the work which will require experimentation. Logically this should start with the minimum amount in order that the cost may be kept as low as possible to the individual builder. The adaptation of machines and labor-saving equipment will be but another logical step, however, as contractors find it to their advantage to undertake the work.

**Finishing.** The methods of finishing the completed walls is another point to be considered. From service records it would appear that the bare walls would stand except under the most severe climatic conditions. Aesthetic reasons, however, will usually prompt some rendering of the walls. Finishes which have been used consist of "dagga" plaster (composed of a mud and manure mix) oil, bituminous coatings, proprietary waterproofing liquids, white wash and water paints, cement washes and lime and cement stuccos, the latter applied both to the bare walls and to reinforcing wire or metal lath applied to the walls.

It is possible that other finishes may be developed. In the "American Architect" of February 23, 1921, appeared the following note: "The discoveries of Sehliemann at Hissarlik showed that among other remarkable methods of ancient buildings was the practice of vitrifying the walls after erection. And he put forward the idea that the walls had been built of unburned clay and then vitrified by the subsequent lighting of huge fires on both sides at once. The interest for us lies in the transformation of a singularly perishable material into an almost imperishable one." Future practice may include the finishing of the walls by the torch.

For interior walls lime and cement washes, paints and wall paper applied directly to the sized earth wall have been used. Interior or partition walls of earth are necessarily much thicker, hence require more costly space, than walls of other materials. The economics to be secured from interior walls of earth will depend to a large extent upon the development of a cheap method of finishing the earth satisfactorily.

**Design.** It is essential to economy that the design should be suited to the construction. This involves square or oblong plans without breaks or offsets, concentrated openings to leave as much bare wall space as possible and the avoidance of high walls and gables. Wall thicknesses are much greater than are ordinarily dealt with, the tensile and compression strengths likely to be secured still of uncertain range and the labor factor an essential item of expediture. Many new developments in structural use of the material are certain to appear as more attention is devoted to this phase. The possibilities of building foundations of the earth itself, as has been practiced in some localities, may prove entirely acceptable in this country for certain conditions. The building of fireplaces and chimneys of the material presents interesting possibilities, and the use of earth layers as the roofing for certain classes of structures appears entirely within reason. For the present the thing which is most needed is a set of minimum requirements and specifications such as has been devised for using the standard construction materials. Once given a groundwork, individual initiative is certain to develop many interesting ramifications.

The newness of the material to our modern artisans constitutes one of the disadvantages to be mastered. No one should attempt any building in this material who is not willing to give it the same intelligent use demanded by other structural materials. It would appear from the experience of those who have dealt in the material successfully that the necessary experience and skill is not difficult to acquire.

## Advantages

**Cost.** The first advantage claimed for earth wall building is its cheapness compared to other methods of construction. With material available at the location the labor item is the only thing to be considered in the wall cost. To a certain class of builders, especially farmers, who are notorious for their failure to place a value on their own labor, this phase appeals as an advantage in that it effects still further economies—more properly reduces the initial expenditure required. Costs are certain to vary according to the individual and the method of building used. Suffice it to state that all official reports indicate highest quality earth building to be cheaper than any other equal grade of masonry construction and in close competition to quality frame building.

Press notices, in general, have been misleading and economies claimed for percentage saving of total structures costs which should have been of the wall construction only. But even though the wall cost is but one-fourth or one-fifth of the cost of the completed structure, as for a small residence, it may be possible to effect decided economies as contrasted with other materials. In an experimental pise' construction in England a twelve-inch wall cost $3.60 per square yard as contrasted with a cost of $6.00 per square yard for an eleven-inch hollow tile construction. In southern California a contractor erects adobe block walls twelve inches thick, plastered two coats outside and three inside with concrete lintels and sills at a contract price of $5.50 per square yard. An 8-inch wall similarly finished is built for $4.50 per square yard.

Advocates of earth wall building propose many other advantages of this style of building, several of which are fully as important as the matter of cost. Using material available at the site, transportation expenses will be entirely eliminated. Another saving of national importance would result in the conservation of our lumber supply.

**Physical Properties.** Earth walls are fireproof, insulating, vermin proof, have small upkeep expense, and are practically indestructible from natural causes if they are

protected from moisture. An incident is related (4) of a French church 80 feet long and 40 feet wide, which was built with pise' walls 18 inches thick and 50 feet high, which burned after 80 years of service. The walls remained unprotected from the elements for a year before an attempt was made to tear them down but they were found so difficult to demolish that they were used in the restored church. Many tests have been made on the bearing strength of earth. The average of these made on suitable soils, correctly handled fall between the range of 10 to 30 tons per square foot.

Capt. B. J. Owen, director of the Institute of Agricultural Engineering, University of Oxford, England, writes, "There are many villages and small towns in England where a large proportion of the buildings, certainly over 200 years old, are of cob, pise', or other form of mud walling. During the recent abnormally wet year (1924), no special troubles have benn reported as affecting the experimental rammed earth cottage built by the Ministry of Agriculture and Fisheries, whereas many brick, concrete and other more orthodox structures about the country have given grave trouble from internal damp."

Earth walls correctly made are air proof and wind resisting, important considerations in some localities.

Prof. W. W. Mackie, of the division of agronomy, University of California, states that from his experience in Mexico and other similar countries occupants, especially women occupants, of earth wall houses are less nervous than those residing in frame structures. He questions whether this may not be due to some insulation effect of the earth wall against atmospheric electricity. Future experimentation may establish interesting phenomena in this field.

And finally, architects and others interested in the aesthetic are intrigued by the possibilities of improved artistry in earth building. The deep reveals and heavy style promoted by the massive wall masonry have a refreshingly novel aspect.

### Conclusion

There will be many skeptics to any development of this system of building. Many, however, will be similar to the correspondent noted by Mr. Young (7), who wrote from Foochow, China, describing the mud hovels common there as being uniformly insanitary and insecure when subject to heavy rains or floods. He failed to consider that there are none of our other materials which are not likewise capable of being misused and which do not have inherent weaknesses which we must accept or design against.

As stated in the beginning of this article, the idea of earth wall building is not advanced for universal adoption. The fact, however, that the government and officials of several countries have seen fit to consider the subject in their reports surely can be construed to mean that it can be made to serve a useful purpose. (13, 14, 16, 17)

## Bibliography


(1) Spectator, Vol. 124, No. 550, April 24, 1920
(2) Spectator, Vol. 124, No. 202, February 14, 1920
(3) American Builder, November 1923
(4) Cottage Building In Cob, Pise', Chalk and Clay—Clough Williams—Ellis (1919) Charles Scribner's Sons, N. Y.
(5) Spectator, Vol. 124, No. 715, May 29, 1920
(6) Spectator, Vol. 125, No. 664, November 20, 1920
(7) American Architect, April 14, 1920; January 26, 1921; and May 6, 1925
(8) Handbook on Building Walls with Rammed Earth—Coffin-Humphrey (1924), The Publicity Corporation, Washington, D. C.
(9) Modern Pise' Building (1924)—Ellington, Karl J. Ellington, Port Angeles, Washington.
(10) Journal of Agricultural Research, Vol. 28, No. 6, May 1924
(11) Journal of Industrial and Engineering Chemistry, Vol. 13, No. 6, June 1921
(12) Report on California Highways—1921, Calif. State Automobile Assoc.
(13) Building In Cob and Pise' de Terre—Special Report No. 5—Building Research Board British Department of Scientfic and Industrial Research, H. M. Stationery Office, Imperial House, Kingsway, London.
(14) Experimental Cottages—British Dept. of Scientific and Industrial Research, H. M. Stationery Office, Imperial House, Kingsway, London.
(15) Pise' de Terre Construction—E. T. Baines—Pise' de Terre Construction Company, Ltd., 118 Cullinan Bldgs., Johannesburg, S. Africa
(16) Journal of Department of Agriculture—Union of South Africa, Vol. 4, No. 4, April 1922; Vol. 5, No. 3, Sept. 1922
(17) New Zealand Journal of Agriculture, March 21, 1921
(18) Architect and Engineer, April 1922


## Meeting on Pyrotol Distribution

DURING the nineteenth annual meeting of the American Society of Agricultural Engineers, held in Madison, June 22 to 25, the men directly interested in the distribution of pyrotol, the salvaged war explosive, were called together by S. H. McCrory, chief of division of agricultural engineering, of the U. S. D. A. Bureau of Public Roads. There were twenty-one men present, representing almost all the states which are largely interested in this work. Mr. McCrory outlined the plan of distribution for the coming year which is the same as was followed last year except in minor details. He also discussed plans for the future and made suggestions as to the methods of carrying on this work so that the maximum benefit might be obtained from this distribution of surplus war explosives. There followed a round table discussion of various phases of the work, its problems and benefits.

The discussion brought out the fact that while this distribution had saved millions of dollars for the farmers of the country, a much greater benefit had been secured by using these explosives as a means of interesting the farmers in improving the conditions of their farms, so that greater crops could be raised at a less cost per acre. It developed that the value of this work was independent of the age of the farm as the oldest as well as the newest states were vitally interested. Also the value of this land improvement work is as greatly appreciated in localities where land values are high as it is in the less developed sections. Also the need for such improvement is not a temporary but a continuing need, for the general opinion bore out the statement of Prof. John Swenehart of the University of Wisconsin that Southern Wisconsin will continue to use large quantities of explosives for land development work for the next forty years, and Northern Wisconsin for the next one hundred years.

Methods for giving instruction in the safe and efficient use of explosives were discussed, and it was the general opinion that the field demonstration by experienced and capable men was the best method which could be employed for this purpose. That such demonstrations can be made valuable even in those sections where explosives have been used for long periods was clearly brought out at the meeting. Various problems encountered in the several states were discussed and remedies suggested from the combined experience of those present.

The meeting was scheduled to last two hours but so spirited was the interest shown that it ran for a much longer time, and the discussions were carried on less formally in group meetings throughout the remaining days of the A. S. A. E. meeting. This conference was so helpful that plans are now being perfected whereby more time can be devoted to the discussion of this work at the next annual meeting of the Society.

## Meeting of North Atlantic Section

THE next meeting of the North Atlantic Section of the American Society of Agricultural Engineers will be held at Schenectady, New York, December 10, 11 and 12. The new Van Curler Hotel has been selected as headquarters, and all meetings will be held in the hotel. Special rates at the hotel, from $2.50 up, have been secured, and members attending the meeting are urged to make their reservations well in advance.

The Local Arrangements Committee and the Committee on Meetings and Programs of the North Atlantic Section are making plans for a meeting that will be of outstanding interest and benefit to those who attend.

# Rural Electric Investigation in California *

By Ben D. Moses

Executive Secretary, California Committee on the Relation of Electricity to Agriculture

THE California Committee on the Relation of Electricity to Agriculture was appointed at a meeting of representatives of farmers, California agricultural experiment station and the electrical industries in May, 1924. This committee consists of L. J. Fletcher, division of agricultural engineering, University of California, chairman; E. O. Shreve, General Electric Company, treasurer; B. D. Moses, California college of agriculture, executive secretary; H. M. Crawford, Pacific Gas and Electric Company; J. J. Deuel, California Farm Bureau Federation; A. M. Frost, San Joaquin Light and Power Company; B. M. Maddox, Southern California Edison Company; J. W. Nelson, California Farm Bureau Federation; N. R. Sutherland, Pacific Gas and Electric Company, and C. A. Utley, Pelton Water Wheel Company.

Through the cooperation of the California power companies, who established a budget of $3,000 for the first half year, it was possible to start the work last November of organizing the various projects, select proper committees and start carrying out the investigations. Since that time it has been necessary to engage an engineer for field work and tabulations, and also to employ a half-time stenographer.

It has not been the purpose of this investigation either to develop or recommend electricity or electrical appliances, unless the practice would be economically sound. In order to obtain data that would not only satisfy local conditions in California, but might be extended to other sections of the United States, a very sincere effort has been made to have the tests thorough and to include in the observations all factors that would have any bearing whatsoever on the work. To illustrate this point, let us consider the tests that were recently run in connection with electric milkers.

Seven dairies near Davis which used mechanical milkers were put under test. Wattmeters were used to measure the current, automatic recorders to record the time of operation, and the dairyman's records taken for determining the weight of milk produced. The herds varied in size from 20 to 420 cows, the amount of milk per cow per day varied from 18½ to 29 pounds, and while all were on the same power schedule, the average cost per kilowatt-hour varied due to the different load factors and varying characters of the loads.

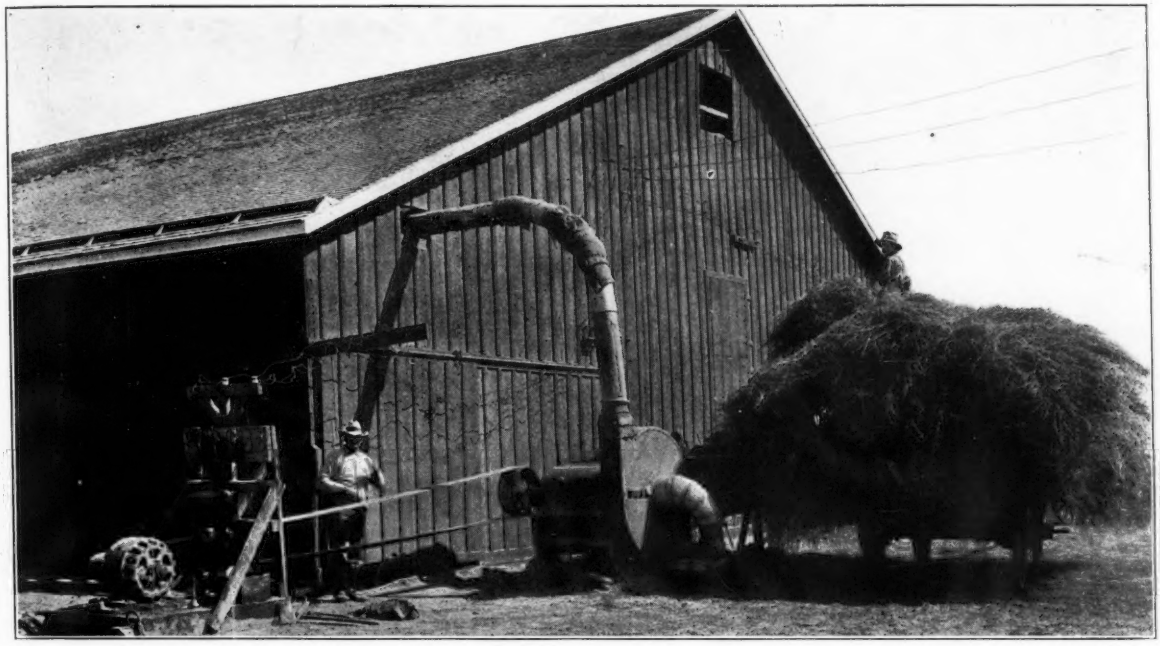
Now, if the cost were used as a basis it would be necessary to know exactly what the basis of charge was in each case. If the cow were used as a basis, or as a unit, results would be uncertain because of the various quantities of milk produced by each individual cow, but in our records we found the amount of electricity required per 100 pounds of milk. Now these two units are the same irrespective of conditions. The electricity per cow per day varied from 0.033 to 0.145 kilowatt-hours, the ratio between the maximum and the minimum being 4.39 to 1. While computed on the basis of electric power per 100 pounds of milk we find that it varies from 0.16 to 0.5 kilowatt-hour, ratio between maximum and minimum of 3.12 to 1. The reason for this variation between 4.39 to 1 and 3.12 to 1 is indicated by the fact that the cows in the first instance produced 20.6 pounds per day and the last 29 pounds per day.

In brooder tests the results have been reduced to the amount of fuel or the watts required per chick per hour. This, however, is not reduced to quite as definite terms as would be most desirable; for instance, the air temperatures, humidity and climatic conditions should be reduced to standard, and likewise the quality of chick should be referred to. By this I mean that while we find in certain localities in California that it requires one watt per chick per hour to brood a chick, in more severe climates where sudden changes are liable to cause wide ranges in temperature, the cost may run up considerably.

In talking with poultrymen relative to the amount of heat required, I have often heard the remark that possibly the man who used the low power consumption raised an inferior chick. It seems, then, that some such unit as the following might be developed so as to make our results more universal, that is, watts required per pound of chick per mean temperature per hour.

*Paper presented at the meeting of the Pacific Coast Section of the American Society of Agricultural Engineers, Los Angeles, California, May 29, 1925.

Deep well turbine operated by a direct-connected 50-h. p. electric motor irrigating a peach orchard through a pipe line



A portable motor driving a hay cutter on the Timm Dairy Farm near Dixon, California. Note the cut-out switch on the barn, below which the temporary connection is made. The motor is also used for cutting ensilage

Here the engineer is confronted with a problem difficult for him to solve because it seems unsettled whether the pound basis would be fair or not, and it would require an expert to judge the chicks in the respective tests. The engineer's mental makeup is of a different order or system than that of the poultryman, horticulturist, dairyman, etc. The engineer is accustomed to dealing with specific constants and coefficients, while specific indexes generally mean little to the practical farmer. If the judging system is employed to classify the chicks into grades, the ability of the judge and possibly his prejudice are liable to affect the results very materially.

The methods that the state director has employed to obtain data and statistics naturally divides itself into three types: first, that of depending upon committees or cooperative groups of men; second, that of cooperating with other departments of the California experiment station, and, third, through direct tests by himself and a field engineer.

As an illustration of the first method, let me cite the activities of our committee on statistics. This committee is composed of statisticians of power companies, a member of the state farm bureau federation, and a member of the sales department of one of the large power companies. After several meetings the committee decided upon two questionnaires; one to be forwarded to the power companies for their filling out, the other directly to the consumer. This committee has drawn up these two questionnaires, has circularized the power companies and has had returns which should make possible, with careful study, the compilation of very valuable and reliable data on the general distribution of electric power to the California agricultural industry. In order to get in touch with the farmer it has drafted a post card questionnaire containing forty-seven itemized questions, this card to be distributed to its rural consumers by the power companies and made returnable to the secretary's office. Through the efforts of this committee the cooperation of practically all the power companies has been secured. Seventy-two companies generating power in the state have been circularized; forty-eight of these have returned the questionnaire filled out; thirty had agricultural load, and fifteen had no agricultural load. The other three are members of some of the larger companies included in the thirty. The companies answering supply over 98 per cent of the electrical energy in alternating current form.

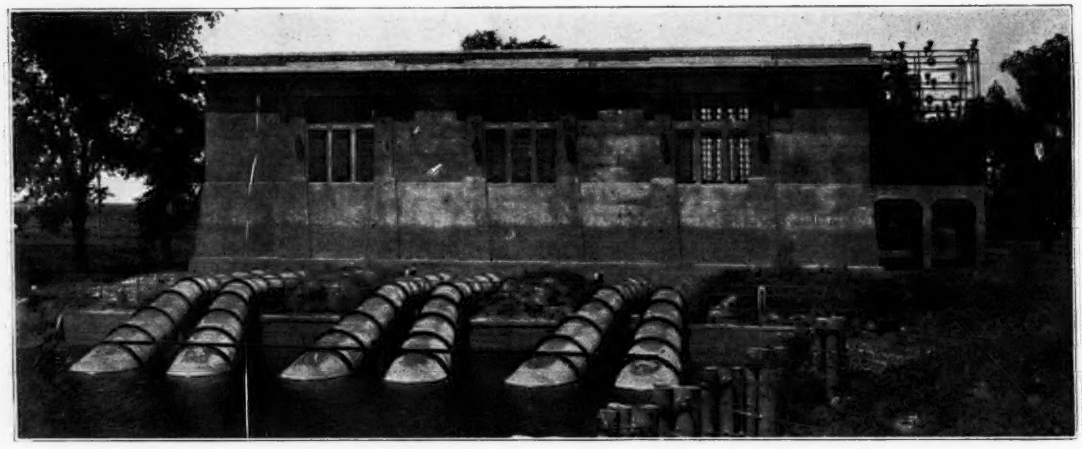
One committee has for its duty the study of the use of electricity in pumping for irrigation. The testing engineer for the Southern California Edison Company, a member of the committee, has submitted a report covering about 300 tests with careful tabulation of pump troubles.

As an example of cooperative projects in other branches of the experiment station it may be mentioned that a separate project is being drawn by the Irrigation Investigation Divisions, University Farm, upon which we are cooperating. This investigation will cover a very close study of the pumping problems in the state.

The committee drafted and presented to the Western Irrigation Equipment Association a standard form of inquiry to be used by the pump sales organizations in the state in selling machinery to the farmer. This inquiry, with slight modifications, has been adopted by the Western Irrigation Equipment Association and their first draft of a standard form of guarantee has been submitted to our committee for its consideration. The purpose of these standard forms is, fundamentally, to establish a common understanding between the farmer and all the pump manufacturers and sales agencies as to what a pump should do under existing conditions. The meaning of such terms as "head", "discharge", "suction", "efficiency", etc., will have a uniform definition throughout the state.

Another committee is devoting its attentions to the investigation of dehydration plants. Many tests on various types of dehydraters have been made in the state by Prof. A. W. Christie, of the University of California, and these tests are being studied. A tabulation resulting from their study and of various references will show the physical characteristics of various fruits and nuts suitable for dehydration. It will also contain construction and test data on plants now in operation. There seems now to be no definite available data that would enable an engineer to design a dehydrater or would enable the farmer to tell him what he wants. The information is scattered through reports of tests, bulletins, newspaper articles, government circulars and text books, and it is our idea to reduce everything of authentic nature and bearing on the problem of dehydration to one concise, well-arranged table.

In our search for a problem in connection with the poul-



DRAINAGE PLANT OF THE SUTTER BASIN COMPANY NEAR SACRAMENTO, CALIFORNIA
This plant consists of six 50-inch pumps, each direct connected to an 800-h. p. motor, the capacity being 540,000 g. p. m. These pumps control the ground water level by removing the seepage and surplus irrigation water from 60,000 acres

try industry, electrically operated brooders seemed to be the thing demanding most attention. The incubator seems to be satisfactory, but the brooder has not yet proved eminently so. For this reason we have devoted considerable time to the test of electric brooders. From our work it has developed that the factors that enter into the design of a satisfactory brooder are, first, the generation of heat, second, the obtaining of proper ventilation, and third, the provision for a comfortable place for the chicks to rest. This application, like many of the other mechanical devices found on the farm, undoubtedly originated with the farmer. Many an orphan chick has been brooded in a basket or box, set in a warm room before the engineer or manufacturer thought anything of artificial brooders. The farmer then attempted to build a mechanical substitute for the hen and keep the chick warm through its early life until it was sufficiently feathered and had the vitality to keep itself warm. The demand then came from the farmer for a machine that would satisfactorily do this work.

The first thing that the manufacturer learned was that it would be necessary to generate heat and to control it. The second thing that he thought of possibly was told him by the farmer, that the heat in the case of the mother hen came from above. The third thing that he either thought of or the farmer told him was possibly that there should be a certain amount of circulation without too rapid displacement of the air. So he built a wooden or metal hen with electric heating elements in the top, soft curtains around the edges and with a chimney or ventilator in the roof. The farmer took this piece of apparatus and as a result lost many a chick. An early refinement was the introduction of the thermostat to control the temperatures within close limits, and still the brooder was not eminently successful. One serious objection, and apparently the first one, was termed "sweating." The chicks would huddle together in the warm region of the hover; the moisture given off by them would condense on their bodies, and they would appear to "sweat." The results were disastrous.

Much prejudice was voiced against electricity being used as a heat; one farmer with whom I talked said that it was "wet." It remained, however, for several of the optimists to continue with the experiments and whether they recognized that circulation was going to be the solution or not, all of the successful changes were founded upon this principle. One poultryman raised the hover and placed a false floor underneath. This floor was made of ordinary lath tacked about one-half inch apart and covered with burlap. Another led the air in underneath the brooder house through a leader pipe and induced circulation by placing a heating element in a chimney rising up under the hover about the center. Still another built a floor with heating coils under the boards and led the air beneath the floor, warmed it, passed it through the floor chimneys, or risers, to the hover, and still another induced circulation by placing ventilators in the top of the hover.

Let us look at these different methods and compare them for a few moments, not from the standpoint of judging, but simply from the standpoint of study. The first one with the lath permitted circulation beneath the floor but did not induce it and had no control over its direction, and the circulation under the hover itself was more or less promiscuous. The second example fixed the circulation and directed it, the air coming up under the hover, passing outward radially and finally out through the curtains. The third using the heated floor obtained similar results with the additional feature, however, of having warm floors for the chicks to rest upon. The last induced circulation and controlled it to a degree, causing the air to come in through the curtains and pass inward radially and upward out through the top.

In the design of the hover, the location of the elements and the size and length of the wire, are very important factors, but sight must not be lost of the room construction, whether the walls and roof are tight, the location of windows and type of floor, and of the fact that each little chick itself is a heating unit. This last statement was borne out very nicely in our tests and several amusing incidents might be related.

One brooder house permitted of metering five brooders in a row, all under the same roof and under very uniform conditions. No. 1 at the west end of the building charged with 300 chicks required 257 kilowatt-hours in 672 hours; No. 2 charged with 400 chicks required 187.2 kilowatt-hours; No. 3 with 400 chicks required 152.3 kilowatt-hours; No. 4 with 400 chicks required 212 kilowatt-hours; No. 5 had no chicks but was run empty and required 293 kilowatt-hours, all being run for the same time and at the same time.

An examination of these figures shows that the brooder without any chicks at all required more power; in other words, the chicks warmed up the brooders to a certain extent. Also it shows that the nearer the center of the row that the brooder was located the less power was required, indicating that the brooders received part of their heat from their neighbors. The owner of this plant relates that when he read the hover thermometers each morning they registered low, and he was a little bothered to know the reason; the recording thermometer also showed a decided drop in the hover temperature each morning at the time that he read it. His final explanation was that as he stepped into the brooder house the chicks hearing him vacated the brooders carrying their little body furnaces with them and causing increased air

displacement, resulting in a temporary chilling of the brooder. The thermostats, of course, kicked in at once, but the heating elements had not sufficient capacity to cause an immediate rise in temperature.

This same man relates also that one morning he noticed that the meter on one brooder was running slow and the meter on the next one was running fast. He examined the thermostats to see if they were all right and checked up on the electrical connections, but everything seemed to be in good working order. The next morning he was surprised to see that the meter that ran slow before had almost stopped and the other had speeded up very noticeably. This he thought called for an investigation and here is what he found: About half of the chicks from the brooder that was running fast had changed their "boarding house" and moved into the brooders that had slowed down.

The tests that have possibly absorbed most of our time and received the greatest attention were those made on stationary spraying plants. This is a cooperative project with the Horticulture Division. A survey of the various spray rig manufacturers showed that there are approximately 10,000 portable spray rigs used in California for spraying orchards, consuming something like 10,000,000 horsepower-hours per year of energy. This seemed to be quite a sizeable load, and is practically entirely delivered by gas engines.

Certain features were also brought out in talking with various orchardists that focused our attention on the development of a stationary or central spray plant, and investigation revealed that seven farmers in the northern part of the state had already piped their orchards and were pumping their spray material through these pipes from a central pumping plant. The main reasons for their using this system were that spraying could be done at any time irrespective of the condition of the ground, cover crop, or trees, that little damage resulted to the branches or fruit by the operation, that by having a number of hydrants throughout the orchard large crews of men could be put to work and the spraying hastened very materially.

Very careful tests were run taking pressures at the nozzles, at the hydrants and at the pump. These pumps run under pressures varying from 250 to 500 pounds per square inch, but the quantities discharged are small. Two types of nozzles are used; one, known as the "gun," shoots the spray into the air and can be directed by the operator; the other consists of a long bamboo rod with an aluminum pipe core, having an atomizer on the end; this rod directs the spray accurately. The rod uses about one-half as much spray material as the gun, but necessarily takes a longer time.

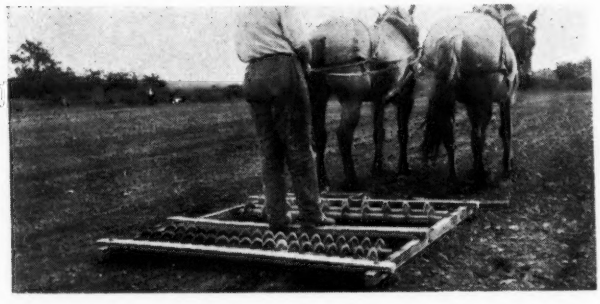
Tests on these plants showed that a man with a gun might spray from 14 to 26 trees per hour, with a rod from 6 to 9, or that each man could cover from about 0.33 acres per hour with a gun and 0.175 acres per hour with a rod.

In addition to the work that has been done in securing these data, certain service has also been rendered by our engineer. For example, a short circuit was found in one of the starting boxes which was passing about ten amperes to the ground whenever the motor was running. The engineer also called attention of one operator to the serious vibration caused by the flapping of the belt, and when asked what could be done about it, offered the simple expediency of moving the motor back and increasing the belt length. This was done with the result that the belt runs smoothly. In another instance attention was called to the long transmission line from the transformer to the motor and to the serious line drop incident to the use of too small wire, amounting to something like 35 volts in this case. On another ranch the farmer stated that his water heater had never worked satisfactorily but had always been slow. The engineer, upon investigation, found that it was a 220-volt heater but was hooked up to the wrong leg and was on a 110-volt circuit. Changing over improved the performance of the heater materially.

During progress of our work we are ever on the lookout for new uses, and future investigation will very likely deal largely with their development. The application of the portable or general utility motor to the various operations will reduce the demand charge and result in lower power bills. The use of double-throw switches will permit of the running of only one motor at a time, accomplishing the same results.

One farmer has built a vacuum cleaner for cleaning out his poultry house, and there is a general demand from the dairyman for some type of electric sterilizer that will heat enough water to wash their cans and have sufficient heat to sterilize them. Many conveniences, such as electric plates and heating elements, are put in different places on the farm. One man uses a plate to heat the water in a ten-gallon container used to wash the cows udders, the same heater is used to warm the calves feed. One poultryman has a space heater placed directly above him while examining day old chicks, in order to keep them from being chilled.

In closing I would like to emphasize one point that I have tried to bring out in this paper and which might have been more or less obscured by the detail, that is the relation which exists between the engineer and the farmer. In order to design, construct and develop mechanical devices to be used in agricultural production, the engineer must either know or must be able to obtain, first-hand information of the technical agricultural requirements. Every engineer cannot be a farmer and every farmer cannot be an engineer but close cooperation between broad-minded engineers and broad-minded farmers, should save much time, money and worry to our farming public.



Tillage, the oldest and most extensive farm operation, is the least understood from a scientific standpoint. The accomanying article gets down to fundamentals Photo from E. R. Gross

## The New Kentucky Hog House

A NEW type portable individual sunlight farrowing house has been designed especially for Kentucky conditions by J. B. Kelley and E. J. Wilford of the Kentucky college of agriculture. It provides for warm, sanitary and convenient spring farrowing quarters, and at the same time a maximum of sunlight.

The gable roof is at a 45-degree angle on the south side which contains windows. Common sashes are used with notches cut in the cross bars. The steepness of the window side of the roof and the notches cut in the crossbars permit the water to run off rapidly. This overcomes the objection often raised regarding water entering through roof windows. The north side of the roof is less steep and longer. The house has been tested in several driving rains, and no water entered through the windows.

The house is 8 by 8 feet, with a 3-foot front wall and a 3½-foot rear wall. It is 6 feet high at the peak of the roof, which permits a man to enter without difficulty to care for the sow and pigs. Placed on 4-by-4 runners, it can be pulled about by a span of mules. The material for the house being used on the agricultural experiment station farm cost $33. By adding 2 feet to the length, or making it 8 by 10 feet, quarters are provided for two small sows.

The house provides ample ventilation, so the door can be closed, and the sow and pigs still receive plenty of air through ventilators at the gables. It is also designed to provide summer shade, the front and rear walls being on hinges, so they may be raised. The door is double, which permits the upper half to be opened for additional ventilation in fair weather.

# The President's Annual Address *

By H. B. Walker

Professor of Agricultural Engineering, Kansas State Agricultural College

CUSTOM has decreed that the president of the American Society of Agricultural Engineers shall make an annual address. I am charged with making the nineteenth of such addresses to the membership of this Society.

Eighteen years ago a small group of men interested in the development of the engineering phases of the agricultural industry, met here in Madison, Wisconsin, to lay the foundation of our Society. A number of these men are in this room today. I wonder what their impressions may be of our accomplishments following eighteen years of continuous work. I understand the group at that time had considerable difficulty in selecting an appropriate name, yet somehow and in some way a vision came to those pioneer workers and our comprehensive, much beloved, and highly respected name—American Society of Agricultural Engineers—was adopted. This name, in my judgment, has had a vital influence on our progress. It carries with it a vision of service, an inspiration for action, and stimulates pride and dignity in membership. It is indeed fortunate that this group of eighteen years ago endowed our Society with such an appropriate name.

A name in itself, however, cannot actually achieve, it is those who adopt, or fall heir to a name or title, who are responsible for achievements. I am sure the honesty, industry, ideals and vision of those charter members are reflected in our present membership, and these have been important factors in our growth. We have grown from a mere handful of college workers into a national society of approximately four hundred members. This membership is scattered not only throughout the United States, but we now number our members in twelve foreign countries.

This progress has been possible because each member has accepted a responsibility of service. Our members have worked not for personal gain, but for mutual benefit. I am sure I can truthfully say, after my brief experience as president of this Society, that I have never before been identified with a technical or industrial group, where such a high percentage of the membership was actually contributing to the progress of the organization. This is a healthy condition bespeaking continued growth and greater technical responsibilities.

It has been this willingness to work upon the part of our membership that has brought to conclusion another year of accomplishment. Your president has enjoyed the finest cooperation and help from the officers and members in all matters coming before the Society. The responsibilities of this office came upon me unexpectedly and with a shock, due to the passing of our late president, Frederick W. Ives. We have lacked his personal guidance in the past year, but I am sure his inspiration has been with us throughout the year and has stimulated our activities. I have endeavored to the best of my ability to carry out the policies and plans of the president of your choice, and your willingness to share responsibilities, your fine team work, and your apparent faith in your president, have made my Society associations very pleasant and my official duties less arduous.

The development of our organization during the past eighteen years has brought into existence four divisions of Society effort, namely: Farm Power and Machinery, Farm Structures, Reclamation, and College. Each of these divisions is a comprehensive unit which must function in unison with the others if the ultimate purposes of our Society are to be attained. The rapid growth of our Society activities, with a member's interest centered about a particular division, may have a tendency to detract our attention at times from the combined activities of our membership. It is incumbent, therefore, upon each of us to keep constantly in mind the united efforts of our organization, because it is through such efforts that we will render the best service and get the greatest recognition. In bringing about this balanced interest it is not necessary to detract from the interest of any progressive division or group of workers, but rather it is of mutual interest to lend support to divisions or groups which may be doing less intensive work.

**Farm Power and Machinery.**—The Farm Power and Machinery Division, through the able leadership of president-elect Wirt, has had a very successful year. This division has inaugurated the custom of special divisional meetings with such success as to justify further efforts in this direction. Agriculture has become a capitalistic enterprise in which managerial ability is becoming more and more recognized. The development of the managerial features in agricultural production is centering more attention on the efficient utilization of energy in farm operations. The development of this field of study and investigation is one of the functions of the Farm Power and Machinery Division. In the past, I fear, our Society has been altogether too modest in attacking these problems of efficient utilization of power in farming. The most flexible cost units today in farm production are those involving power and labor. It is true that price of land, taxes, and interest rates are factors in production, but these are not under the direct control of the producer. On the other hand, items of man labor and power costs are dependent largely upon the managerial ability of the farm operator. These are costs in production which are influenced through the efficient operation of labor-saving farm machines.

This Society at present enjoys leadership in directing attention to the importance of power in the managerial side of agriculture, but as yet we have only entered upon our endeavors. The division meetings during the year have been successful in bringing engineering leaders together for the discussion of problems relating to the use of power and labor-saving devices in agricultural production. These meetings are very helpful to us in working out logical programs for action, and the personal contacts are of great value to those who attend.

The successes attained during the past year should lend encouragement to further efforts.

**Farm Structures.**—The farm is an industrial unit. The structures on the farm contribute to the success or failure of this unit, and have much to do with the attractiveness and comforts of farm life. The Farm Structures Division has a tremendously important task to perform. Although our Society has contributed materially to the betterment of structures on the farm, I feel that we are permitting opportunities for service to escape. This statement is not made as a criticism of work accomplished, but rather to attract attention to fields of efforts so far practically unexplored. Our work in farm building ventilation is outstanding, and we have done creditable work in barn framing and standardization of barn equipment. In my judgment, however, we have not devoted sufficient attention to better farm homes, fireproof construction, farm building codes, farm sanitary codes, and the efficiency of labor-saving farmstead equipment. We are all interested in these problems, but stress of other duties and lack of direction have caused the entire membership to be somewhat negligent. A greater percentage of our membership should be active in the work of the Farm Structures Division.

**Reclamation.**—The agricultural engineer is an important factor in successful reclamation. The big problems coming

*Delivered before the nineteenth annual meeting of the American Society of Agricultural Engineers, Madison, Wisconsin, June 24, 1925.

up in any reclamation program, whether by irrigation, drainage, land clearing, or soil erosion, are largely those of economics and agricultural engineering. The work of our Reclamation Division is attracting wider attention each year. When it is remembered, that this division is but a few years old I believe we can look upon our growth as nothing short of phenomenal. With improved markets for agricultural products, and with continued growth in our national population, we can rightfully expect the interest in reclamation to take on new life. This division must keep its work well balanced to meet the demands which may come upon it at any time, by giving proper attention to drainage, irrigation, land clearing, and soil erosion.

The members of this Society should acquaint themselves with the national policies of reclamation. We should be active in these matters if we hope to assume an important place in future agricultural development by reclamation. The Society counts among its members many of the best known reclamation engineers of the nation. We are in a position to assume greater leadership in this important field particularly in problems of land settlement and crop production. The plan of the Society to hold its next annual meeting in the West affords a splendid opportunity for the development of an unusual irrigation program in 1926.

**The College Division.**—The College Division occupies a prominent place in Society affairs. It was the educational objective that prompted the first meeting of this Society eighteen years ago. Education must always occupy an important place in our development. The introduction of mechanical equipment, the building of efficient farm structures, and the economical reclamation of land, all carry an educational responsibility for final success. Agricultural engineers must be trained to accept responsible places in these respective fields. Not only this, but men must be made available for investigation and research if we are to grow in technical standing and achieve worthwhile results.

The educational work of our state institutions is noteworthy, and contributes much to the development of our organization. Approximately forty per cent of our membership are engaged in agricultural engineering education and research. The time has come, however, when the interests of our Society will be best served by having a higher percentage of our membership represented in the related agricultural industries. The College Division has recognized this need, and has formed a contact committee, the Committee on Cooperative Relations, the purpose of which is to encourage more direct and mutually helpful relations between the industries and the agricultural engineering profession. The major work of this committee to date has been with a similar committee from the National Association of Farm Equipment Manufacturers. These committees have been cooperating for more than two years with definite results.

I shall take the liberty to mention two achievements resulting from these contacts which are of vital importance to the membership of our Society.

The implement industry is interested in inducting agricultural engineering graduates into their organizations. This interest does not open up any short-cuts to success for young and ambitious agricultural engineers, but it does provide logical methods of training and development for the young man who wishes to enter such commercial fields. One company expects to take into its organization this year ten graduate agricultural engineers. Other companies are taking men, although fewer in number, and still others are making preliminary preparations to establish apprentice courses which will be inaugurated later. To me, this action on the part of the industry opens up opportunities for professional growth which have hitherto been quite restricted. It affords an opportunity for more industrial growth in our society, it provides a more definite objective in agricultural engineering education, and if I am not entirely in error, it will mean more rapid advancement for the industry, and better products for the consumer. We must not assume, however, that the mere adoption of a system of induction of agricultural engineers into such fields ends our responsibilities. In fact, it only adds to our responsibilities. We must make good with these plans, and I know I express the sentiment of this Society when I say we will make good.

Another result of the activities of the Committee on Cooperative Relations has just recently come to fruition, and this is likewise of vital interest. For a number of years the membership of the Society has realized that substantial growth is based upon well thought out and comprehensive plans for action. The activities of the Research Committee have educated all of us to the need and usefulness of investigations and research in our particular fields of endeavor. This problem of research and investigation has been a subject of discussion between this committee of our Society and a like committee of the National Association of Farm Equipment Manufacturers. Research and investigation in farm equipment have not received as much attention as its importance deserves. It is a field of study, however, which should produce results of value not only to the agricultural producer but to the manufacturer of agricultural machines. The two committees in their discussions of research reached mutual agreements on several points of common interests and pledged their support and cooperation to any logical plan which might be developed.

Agricultural engineering is essentially a product of land grant colleges. Since our land grant colleges cooperate with and receive support from the federal government it is only logical that any studies, surveys, investigations or research undertaken, should be worked out in cooperation with federal agencies. With this in mind representatives of the two committees conferred with the Honorable Secretary of Agriculture at Washington, D. C., and suggested a general plan for cooperative effort. The committee's request received a hearty response from the Secretary, who assured the representatives not only of his general approval, but he definitely indicated to the committee that approximately $10,000 would be set aside at once as a beginning on an investigational and research program in the farm equipment field. It was distinctly understood, however, that if such a program of effort was to be carried out cooperatively between the various agencies concerned, each should share its just part of the responsibility for success.

I do not have the time to present further details of cooperative efforts between this Society and industrial organizations. I have pointed out these two accomplishments as indicative of what may be done through cooperation with other agencies having interests in common, or complimentary to our own. These cooperative relations should be encouraged whenever mutual benefits will follow, but it must be remembered that the success of cooperation depends, primarily, upon mutual interests and mutually helpful results; otherwise there is little need for such effort.

**Rural Electrification.**—Rural electrification has taken a prominent place in the thoughts of many agricultural engineers. The development of electrical uses in agriculture are largely agricultural engineering problems. This problem has come to us without much solicitation upon our part. I might even suggest that it has been tossed into our midst. Here is a big opportunity for agricultural engineers to prove their worth. Many investigations are now under way and considerable sums of money are being expended to hasten the solution of the problem. We must proceed with care. Well thought out plans must be laid, if the funds available are spent wisely and the public benefited. We are making progress. Correlation of our efforts in a sensible, workable way is essential and desirable, and our problem should be attacked with a definite purpose and with a vision of ultimate objectives.

The amount of attention this problem is receiving from our membership at this time justifies, I believe, the formation of a rural electrical division in the Society. It is true that, fundamentally, rural electrification is very closely related to farm power and machinery, but it likewise overlaps to a more or less extent the activities of other divisions of the Society. For the present at least, while this line of work is in such an active development period, I favor the formation of a rural electrical division. This is a big opportunity for our Society. We should prepare for this responsibility by creating the necessary working organization for unhampered and rapid growth.

The electrical interests are expecting agricultural engi-

neers to become active. This is evidenced by a resolution which was adopted at the annual convention of the Middle West Division of the National Electric Light Association at its May, 1925, meeting in Omaha. I shall quote this resolution.

WHEREAS: There exists a need for agricultural engineers, who have had training in electrical engineering, and whereas the supply of men trained as agricultural engineers, and even more so, agricultural engineers with electrical training is very limited,

BE IT RESOLVED: First, that the universities and colleges now giving training to agricultural engineers be encouraged to give such men facilities for training in electrical engineering and that facilities for research in the application of electricity to agriculture be provided.

Second, that the electric light and power companies and the manufacturers of electric equipment give the men, who are now studying agricultural engineering, an opportunity to study electrical-agricultural problems by offering summer employment to such men, and

BE IT FURTHER RESOLVED: That copies of the above resolutions be sent to Dr. W. M. Jardine, Secretary of Agriculture; to the presidents of the agricultural colleges; deans of the departments of agriculture in the universities; to the chief of the division of agricultural engineering in all colleges where work in agricultural engineering is now offered and to all of the state or district directors of committees on public utilities information; that this resolution be printed in the N. E. L. A. Bulletin, in the C. R. E. A. Bulletin, and be given such further distribution as may seem advisable.

The Committee on Cooperative Relations of the College Division is working on this problem of education in cooperation with a similar committee of the National Electric Light Association. The resolution just quoted is a result of this contact work.

**Research and Investigation.**—Our Society has been fortunate in having its Research Committee headed by a man who devotes his entire time to the experimental and research fields. The work of this committee has stimulated a large number of our members to think about problems which require original investigation. Such stimulation of thought by this committee is a real accomplishment if immeasurable value to the ultimate growth of our organization. So much has been said of research lately, and so many activities are carried on under this heading, as to be somewhat confusing to all of us when the term is mentioned. I shall not attempt to inflict upon you any personal opinions of my own. It is apparent, however, that agricultural engineering is hampered in its growth by a dearth of organized and properly digested facts, and a lack of many undiscovered truths. It is my opinion that this fundamental and useful information must be acquired through a combination of study, surveys of practices, experimental work, investigations and research. It matters but little, ultimately, what we may designate these things, as long as the fundamental truths are secured which will promote safe and substantial progress without waste of effort. The Research Committee will have an increasingly important task with this growth of activity and interest. We must look to them for careful guidance and in turn we must give our generous support.

**Sections.**—The Society has two organized sections with the possibility of a third section being formed in the near future. The wide scope of our Society, both in fields of work and geographical distribution of members makes the formation of sections desirable. The Pacific Coast Section is doing splendid work and the North Atlantic Section which came into being April 10 of this year is starting out under very encouraging circumstances. We hope soon to have a Southwest Section. A section can do much to cultivate the interest of members in Society activities, which of course in the end contributes to the welfare of the parent organization.

**American Engineering Council.**—Your President is the Society's representative on American Engineering Council. The American Society of Agricultural Engineers is the smallest of the national societies represented on the Council. It is important that we retain our identity with the engineering societies represented. This work gives us a direct contact with other professional engineering groups and widens our field of usefulness. Your representative is chairman of the reclamation committee of the American Engineering Council and three of the nine members of the committee are likewise members of this society. I mention this activity to indicate our recognition in the reclamation field.

American Engineering Council is now active in the reorganization of the government service. The plan now proposed provides for the transfer of the U. S. D. A. Division of Agricultural Engineering along with the Bureau of Public Roads, to the Department of the Interior. This Society is interested in government reorganization which contributes to efficiency, but the proposal to transfer agricultural engineering from the Department of Agriculture to the Department of the Interior seems hardly in keeping with the original purpose of the reorganization plan. I am confident this detail of reorganization can be adjusted to retain agricultural engineering in the U. S. Department of Agriculture where its major work is located, but our Society should take a definite stand as to the action we will pursue in supporting reorganization.

**Forestry.**—Our Society has been represented during the year at the various forestry conferences held at Washington, D. C., under the auspices of the U. S. Department of Agriculture and the Department of Commerce. It is the duty of the Society to maintain active interest in forestry problems and we should lend our full support to any movement looking forward to reforestation and conservation of timber products.

**Society Welfare.**—The American Society of Agricultural Engineers is completing one of its most successful years. It has been a year of effort in which all of us can be proud of our accomplishments. Our membership has grown but little, but apparently we have passed the period of depression in agriculture and related industries, and we can now look to the future with encouragement. We need more members, but these should not be secured at a sacrifice of professional standards. A large proportion of the prominent agricultural engineers of the entire world are now identified with our Society. Our growth, accordingly, cannot be rapid, but it should be substantial. Many men in related engineering fields have an interest in our particular field and should be identified with our Society.

The finances of the Society are the best in its history. We had a right to expect this from the report last year. Our secretary has done more than his share. He has been giving us full time service on part time pay. I am looking forward with confidence to a time in the near future when we will have a full time secretary. Too few of us, I fear, appreciate the importance and responsibilities of the secretary's work. Each member can lighten his burdens by paying his dues promptly, answering correspondence immediately, accepting committee appointments cheerfully, then working diligently with a view of writing technical articles for the Journal.

The division chairmen have direct responsibility for the progress of their respective divisions. The committee appointments in these various divisions should be made promptly and objectives should be outlined for each of the committees to avoid lost motion so far as possible.

We must keep in mind at all times that our endeavors must have a direct economic value to agriculture. In this we must be sound in our reasoning and practical in our applications. Sound reasoning in our profession is founded upon a thorough knowledge of the fundamental principles of engineering science, tempered by an understanding of the basic principles of sound agricultural practices. The development of our work involves something more than mere economic considerations. While agricultural engineering contributes to the efficient use of power and labor-saving equipment we must not stop with mere machines; the farmer must be educated to utilize this equipment so efficiently that his margin of profit will be sufficient to insure for his family better living conditions and more attractive social life. As engineers we cannot permit American agriculture to degenerate to peasantry, but rather it is our duty to make the individual farmer a bigger and more efficient producer, and at the same time keep his standards of living on a plane comparable with those engaged in similar capitalistic enterprises.

Again I want to thank the membership for your fine cooperation. I know you will give to my successor the same fine support you have accorded me.

# Research in Agricultural Engineering

Research activities in the agricultural-engineering field are presented under this heading by the A. S. A. E. Research Committee. Members of the Society are invited to discuss material presented, to offer suggestions for timely topics, and to prepare special articles on any phase of agricultural engineering research

## The Fundamentals of Research *

By Wm. L. DeBaufre

Chairman, Mechanical Engineering Department, University of Nebraska, and Consulting Engineer, U. S. Bureau of Mines

RESEARCH by a business concern is almost as hazardous an undertaking as prospecting for oil. However, to neglect research is more hazardous for a rival concern may discover through research an improved machine or article of manufacture which would enable the rival to dominate the market. Hence, research is a "necessary evil" for any manufacturing concern which desires to remain in business. As a basis for this paper, I will define "fundamentals of research" to be those principles which should govern research to reduce its hazards, that is, to make more certain the dividends industrial research must pay to justify expenditures upon it.

To anyone who may object to considering research on an economic basis, I would reply that the same principles which will enable a business concern to earn dividends on research investments will also result in the greatest good to mankind from research in a non-dividend paying institution. However, it should be remembered that I have the engineer's viewpoint of direct utilitarian service of research rather than the viewpoint glorified by some scientific workers to whom utility is of no interest.

Research in engineering, or applied science, must be carried to fruition by the installation of a new industrial process or machine or the production of a new article of manufacture or an improvement thereon, or it must show that a proposed improvement is practically impossible. In the past, new processes and new materials were often the result of accidents. Today, however, they are the results of engineering research conducted according to the scientific method, which consists of the following fourteen steps:

1. A statement of the object of the research project to develop a certain new process, machine, article of manufacture or improvement thereon, and of the plans for accomplishing this object
2. A search to determine what has been done along similar lines in the past
3. A summary of the typical characteristics of old processes, machines, or articles of manufacture
4. A theoretical analysis of such typical characteristics to discover the relations involved
5. A determination of the numerical constants required in these relations
6. The deduction of a new process, machine, or article of manufacture based on the theoretical relations discovered
7. Laboratory experiments to determine the truth of theoretical deductions
8. The design of an apparatus of sufficient size to illustrate the performance of a full scale unit
9. The building and testing of such a semi-commercial unit to determine its characteristics
10. The theoretical analysis of the test data for the semi-commercial unit
11. The design of a full size unit
12. The building and testing of a full size unit
13. The theoretical analysis of the test data for the full size unit
14. The preparation of a report upon the whole development

Before discussing these fourteen points in detail, it is to be noted that the execution of the whole research project should be under the direction of one person. This person must have the mental capacity to grasp the problem as a whole and the will power to carry it through to completion in an expeditious manner. He should be broadminded enough to determine general policies in consultation with others and to refer special problems to experts for solution. The success of the whole project will depend very largely upon the characteristics of the person to whom it is entrusted, so that too great care cannot be exercised in his selection.

Regarding the statement concerning the object of the research project and the plans for its accomplishment, this should be made in a tentative way preliminary to the selection of the executive head, for the nature of the project will determine the kind of training and experience desired in the executive. The complete formuation of the plans, however, should not be attempted until the research executive has had opportunity to give some thought to the problem. Then the formulation should be made by a committee selected for that purpose in consultation with the research executive. The members of this committee should be selected for a knowledge of the practical conditions to be remedied or of the theoretical principles in physics, chemistry, etc., which will be involved.

If research problems were more often referred to such committees with some members having the latter qualifications, experimental investigations would, in certain cases, be found unnecessary, because the desired information is already at hand; however, such a committee must take the time necessary to study the problem thoroughly, for even eminent scientists have drawn erroneous conclusions through too hasty action.

The possibility that it may be necessary to reformulate the plans as the investigation progresses should not deter as complete a formulation as possible at the beginning. Too much money is wasted upon research undertaken without definite plans. By reason of the probability of needing to reformulate the plans from time to time, the advisory committee should be kept intact during the investigation until the final report is made upon the completed project. In addition to the reformulation of plans for the research, other matters of policy must be determined during the investigation, which can very well be referred to such an advisory committee.

The definite formulation of plans will also aid in estimating the cost of the investigation. It is impossible to predetermine the total cost of any piece of research work. This is necessarily true because research is undertaken to find out something which was not known previously and the final line of attack may be entirely different from that originally thought best. However, a fair estimate of cost can be made for a definite set of predetermined experiments. If found necessary to change the line of attack, new estimates can be prepared from time to time as the plans are varied. Even though funds be appropriated for a certain period, reformation of plans should be made

*Paper presented at the eighteenth annual meeting of the American Society of Agricultural Engineers, Lincoln, Nebraska, June, 1924.

whenever necessary in order to insure the best use of the funds during that period.

The prosecution of experimental work is very expensive when compared with ordinary factory production. In the latter case, the cost of planning and other overhead expenses are spread over the production of a large mass of material. In experimental work, however, much planning is required for a comparatively small amount of work. Yet the planning cannot be curtailed with safety, for such curtailing might render the experimental work useless. Of even greater importance is a search to determine whether the whole problem has been solved previously.

Such a search should be made through the literature pertaining to the subject. The following aids are available for a library search:

1. The Engineering Index, published by the American Society of Mechanical Engineers
2. The Industrial Arts Index, published by the H. W. Wilson Company, New York
3. Science Abstracts (Section A-Physics, Section B-Electrical Engineering), published by the Institution of Electrical Engineers and The Physical Society of London, England, in cooperation with the American Institute of Electrical Engineers and the American Physical Society
4. Chemical Abstracts, published by The American Chemical Society
5. Journal of the Chemical Society of London, Abstracts, published by the Society
6. International Catalogue of Scientific Literature, published by the Royal Society of London
7. Glazebrook's Dictionary of Applied Physics, 1923
8. Thorpe's Dictionary of Applied Chemistry, 1921
9. The Official Gazette of the U. S. Patent Office, published by the U. S. Government Printing Office

Mention should also be made of the Library Service Bureau of the national engineering societies of New York City. The Bureau comprises "a staff of expert searchers and translators for verifying references, furnishing bibliographies of engineering subjects, original prints, abstracts, copies, photographs and translations, and also making searches for patent purposes, prefaces, reference cards, etc. This service is confidential and is available through the mails. When necessary to charge for service it is at actual cost."

The National Research Council also maintains a research information service, the aim of which "is to furnish all sorts of useful informaton about the scientific methods and results, and their practical applications in engineering, industry, and education."

The publications of various government bureaus and of the engineering experiment stations connected with the state and privately endowed educational institutions should not be passed over without notice as a source of much valuable information.

To secure further information on old processes, machines, or articles of manufacture, tests may be conducted on such as may be available.

The files of the U. S. Patent Office should be searched, not only for light on previous work done along the same lines but also to learn whether patent protection is possible should there be developed an improved process, machine, or article of manufacture. The question of patent protection should be considered one of the fundamentals of engineering research because without patent protection certain research cannot be undertaken for commercial reasons. The value of our patent system in encouraging research is probably not generally appreciated.

When all available information has been gathered together, it must be summarized to show the typical characteristics of old processes, machines, or articles of manufacture .

Then a theoretical analysis should be made to find the relations between the physical and chemical data involved. Here a thorough grasp of the fundamentals of physics and chemistry is required. Much help in deriving such relations is afforded by the "principles of dimensions" with which every research worker should be familiar. (See notes on the method of dimensions by E. Buckingham, "Philosophical Magazine," November 1921.) All such relations must, of course, be expressed in mathematical symbols; but it is not mathematics that usually gives the research worker trouble, but the lack of an understanding of physics and chemistry. If the physical relations are properly expressed in mathematical symbols, the solution of the resulting differential equation usually does not present much difficulty.

In such mathematical relations, certain physical-chemical constants will be required. When the international critical tables now under preparation by the National Research Council are issued in a year or two, a very valuable reference work will be provided for such constants. At the present time, we have available:

(a) Landolt-Bornstein Physikalische-Chemische Tabellen, 1923

(b) Castell-Evans Physico-Chemical Tables, 1911

(c) Smithsonian Physical Tables, 1920, and Meterological Tables, 1918.

In spite of the apparently large amount of material published, reliable data are really scarce, and too often the exact constants required will not be available in sufficiently accurate form. It will then be necessary to arrange for some scientific laboratory to determine the physical-chemical constants required.

Having derived relations between the variables involved and found the physical-chemical constants required for use therein, a theoretical analysis should be completed of the characteristics of existing apparatus. Only by such a theoretical analysis can the effects of the different variables be determined in order to eliminate undesirable ones. This will lead to the theoretical deduction of an improved process, machine, or article of manufacture.

However, some new relations may be involved in the improved arrangement. If possible to check the accuracy of these new relations by laboratory experiments on a small scale, the investigation as a whole will be expedited because such small scale experiments often give a valuable insight into the relations between a few variables which are masked by the large number of variables usually present in a commercial plant. Also, it is generally undesirable to force developments that may fail by reason of some defect which could have been avoided if preliminary laboratory tests had been made.

In fact, where the commercial apparatus would be very large, it is desirable to try out the new arrangement at minimum cost with what might be termed a semi-commercial unit, that is, one only as large as necessary to have every part similar in construction to a full size unit. This semi-commercial unit will then have characteristics similar to those of the full size commercial unit, being related thereto by an equation which may often be derived by the "principle of dimensions" previously mentioned. The design of the semi-commercial unit may be based upon the theoretical relations and physical-chemical constants previously found supplemented by data from the laboratory tests. The testing of the semi-commercial unit constructed according to this design will reveal the correctness of the theoretical deductions. A careful analysis should be made of the test data to find whether further improvements are possible.

Then a full size unit may be designed, built, tested, and the resulting data analyzed to insure the best possible commercial results.

Finally, a report should be prepared upon the whole development to serve as a guide for the commercial success of the project and for further developments in the future. Of course, in such an extended development, progress reports will be required from time to time to show the status of the work, and special reports will be required in connection with the solution of individual problems in connection therewith.

Having considered the fundamentals of an engineering research project as a whole, I would like to point out some of the fundamentals for the conduct of the experimental work on the individual problems connected therewith. These remarks will apply to the general run of research work, which is usually concerned with a special problem

rather than with a complete development of an improved process or apparatus. Much of the outline given for the general project may be followed in the solution of the individual problem. For example, there should be a careful formulation of the problem, a study of previous work, a theoretical analysis, and a careful planning of the experiments to be performed. By a careful criticism of such plans before the experiments are undertaken much useless work may be avoided. When the apparatus has been set up for the test, a preliminary run should be made and the data completely worked up to make sure that every necessary observation is being taken to secure the desired information. In fact, if considerable extra expense is not involved it is generally desirable to include some data which may not be considered absolutely essential for the information required at the time. This additional data serves as an insurance against taking too few data, for it is sometimes found that the information would be of wider use if more data were available. All instruments used should be calibrated to insure accuracy of the data. The test equipment should be carefully arranged and set up to render its operation convenient. Even though the test arrangement is only temporary, a slovenly set-up should not be permitted. It should be remembered that carefulness is one of the essentials of accurate research work, and it is human nature to take better care of good appearing apparatus than that of a rough looking installation. For the same reason, neatness in tabulating data and working up results contribute to their accuracy. By insisting upon neatness in arrangement of apparatus and carefulness in recording and working up data, but slightly additional time will be required. In fact, time will generally be economized by reason of the ease of checking results and the saving in repetition of runs having questionable data.

As the value of the time and effort expended upon the research is in general dependent upon the knowledge acquired by others of the results, a report thereon is a fundamental requirement. The methods of calibrating instruments and the details of conducting the test should be minutely described in the report. If something has been inadvertently neglected, a complete and full report may enable a correction to be approximated at some future time when the error is discovered; while the absence of such full descriptions would render the results valueless. Thus, the more extended such a report, the greater its value, provided a good summary is included with the conclusions reached. Such a report should include:

1. Introduction. Giving the reasons for undertaking the investigation and showing the authority therefor
2. Object. A brief but clear statement of the results sought
3. Theory which may be involved
4. Subject. A full description of any apparatus tested
5. Arrangement of the testing equipment should be explained by reference to drawings and photographs, showing particularly the location of all instruments
6. Conduct. The sequence of runs, method of taking observations, etc., should be given, together with statements regarding any unusual events occurring during the runs
7. Calculations. The corrections applied to measuring instruments should be described and the methods of making all calculations
8. Curves showing the relations between the different variables should be included
9. Results. These should be discussed fully
10. Summary and conclusions. By reading these a clear conception should be obtainable of the whole project

In conclusion, I wish to refer again to the advisory committee recommended for a research project. In certain government research projects in England and in this country, very good results have been gotten by appointing such advisory committees, composed of members with various kinds of training and experience in order to view the problem in different lights and on all sides. The execution of the project, however, has been placed in charge of one man, a government employee.

In only the very largest commercial firms are a sufficient number of scientifically trained men employed to bring to bear upon a research project all the necessary viewpoints to enable the problem to be attacked with minimum expense. Concerns of ordinary size are in general lacking in men of high scientific attainments in various lines so that it would be desirable for them to supplant their own staffs with outside talent. For this purpose there are available certain men in our educational institutions, who could very well serve on such advisory boards. Such an arrangement would be highly desirable, both for the commercial firm and for the educational institution. The advantages to the former have already been discussed. From the standpoint of the educational institution, such an arrangement would provide the best form of commercial contacts for its faculty and would enable the institution to keep men who would otherwise leave to go with commercial firms at salaries the institution cannot afford to pay.

## U. S. D. A. Advisory Council in Research

THE problem of research in agricultural engineering is one that has occupied a large share of the attention of the joint Committee on Cooperative Relations of the American Society of Agricultural Engineers and the National Association of Farm Equipment Manufacturers, ever since the committee was organized.

On May 18 representatives of the Committee conferred with Secretary of Agriculture Jardine at Washington and suggested the general plan for cooperative effort. The Committee's request received the hearty response of the Secretary of Agriculture who not only assured the representatives of his general approval, but he definitely indicated to the Committee that a fund of $10,000 would be used to formulate at once an investigational and research program for the farm equipment field.

Following this conference the Department of Agriculture authorized the appointment of an Advisory Council to consist of eight members representing the American Society of Agricultural Engineers and the agricultural engineering departments of the state agricultural colleges, eight representatives from the National Association of Farm Equipment Manufacturers, and three representatives from the U. S. Department of Agriculture.

The following are the men who have been appointed to represent the American Society of Agricultural Engineers and whose appointment has been approved by the College Division of the Society:

J. B. Davidson, professor of agricultural engineering, Iowa State College.
M. L. Nichols, professor of agricultural engineering, Alabama Polytechnic Institute.
D. Scoates, professor of agricultural engineering, Texas A. & M. College.
L. J. Fletcher, professor of agricultural engineering, University of California.
O. W. Sjogren, professor of agricultural engineering, University of Nebraska.
F. W. Duffee, associate professor of agricultural engineering, University of Wisconsin.
R. U. Blasingame, professor of farm machinery, Pennsylvania State College.
C. E. Seitz, professor of agricultural engineering, Virginia Polytechnic Institute.

## An Economic Basis for Sizes

A SYSTEM by which the sizes of such necessities of life as frying pans, loaves of bread, desk tops, trunks, and insurance policy premiums, may some day be established according to a sound scientific principle, is under consideration by a committee recently appointed by the A. E. S. C. to study the possibilities of systems of size-series which are enlisting the interest of many engineers of the industrial countries of Europe, particularly in the mechanical and electrical engineering fields.

These series, which are called "preferred numbers", seek to provide a consistent, systematic basis for sizes, capacities, and ratings.

# Agricultural Engineering Digest

A review of current literature on agricultural engineering by R. W. Trullinger, specialist in rural engineering, Office of Experiment Stations, U. S. Department of Agriculture

**Studies of the Circumstances Affecting the Condition of Drainage Canals** [trans titles], P. Kokkonen (Acta Forest, Fennica, 27 (1924), pp. VI—1-220, pls. 16, figs. 68).—The results of an extensive study of factors affecting the condition of drainage canals in Finland are presented in considerable detail. A review of literature bearing on the subject is given, and the locations where observations were made are described. The studies are divided into two parts. Part 1 deals with the action of materials derived locally in obstructing drainage channels.

Studies of crumbling showed that on the whole this phenomenon occurs in soils of nearly or perfectly loose consistency, such as decayed forest or peat soils or in sandy, silty, and silt clay soils. The range of crumbling was found to be greater in soils in which the channel cuts through overlying peat layers into the mineral substratum, than in peaty and mineral soils alone. It was greatest in the former soils where the subsoil was fine grained. Crumbling is apparently largely brought about by too steep side slopes.

Studies of rolling or slipping breaches showed that such breaches may be classified according to the motion of the earth as rollings, slips, and filling breaches. Rollings were found to occur mainly in sandy and silty soils. Crumbling slips occur chiefly in silty clay soils and rarely in silty soils. Other kinds of slips occur only in clayey and muddy soils and in laminated soils underlaid by clay and mud. Filling breaches occur in muddy, silty, and peaty soils. The deeper the channel the greater was the motion of the earth.

The chief cause of breaches was found to be due to the increase in earth pressure from deepening the channel and cutting the sides steeper. This pressure may be increased if the excavated earth is laid too near the sides. In some cases the earth pressure was found to be increased by damming during excavation and by erosion. A decrease in earth resistance favorable to rupture was also caused by the removal of plant roots, rains, damming, and by earth contraction. It was also found that in all drainage districts in which breaches have occurred the natural soil moisture was very high, amounting in slips to 60 per cent and in filling breaches up to 80 or 90 per cent. As a rule breaches were found to occur in the course of the same summer during which excavation took place.

Studies of upheavals showed that they occur in very wet swamps and fens where the peat has no sustaining power, and in clayey soils if layers of miry clay exist under a stiff layer of earth to which the channel does not quite reach. Upheavals were found to contract channels and sometimes to efface them altogether. The former took place in undecayed, homogeneous swamps with some sustaining power and generally in clayey soils, mainly in those near sea coasts. The latter occurred in especially wet boggy swamps partially decayed. In upheavals, especially those occuring in undecayed swamps, the channel appears to rise up, thus reducing the drainage efficiency of the diminished canal section.

Studies of protrusions showed that one-sided protrusions occur in protecting ditches cut in the outskirts of large fens in the side of the channel bordered upon by the fen. Total two-sided protrusions occurred in canals cut in large fens which were not particularly wet, and which contained relatively few canals or none. It was found that partial protrusion may occur in all such fens and swamps as are covered by a layer of nearly undecayed peat, the deeper layers of which consist of Carex, forest, or Sphagnum peat, or of their mixtures, in decayed form. In partial and total protrusion ground water increased the earth pressure considerably and reduced the consistency of the peat. The principal cause of protrusion is said to be earth pressure.

Part 2 deals with obstruction by materials transported from elsewhere. It was found that earth is transported by the channel water causing crumbling, rolling, and rolling slips above the water level in mineral soils and breaking off, rolling, and crumbling of peat soils.

Studies of the effect of freezing and thawing showed that these phenomena cause softening and crumbling of the sides of channels and the formation of eaves and projections. They also influence the phenomena of obstruction and erosion. Congelation of surface and subsurface soils was found to soften the sides of channels appreciably for some years after excavation. This action was more intensive in well decayed peaty soils, but comparatively weak in a fibrous peat soil. The vertical and horizontal expansion caused by congelation of soil was found to produce phenomena which break the sides of canals. Congelation was also found to be quite active in crumbling, rolling, and fracture slip, and to intensify the action of erosive phenomena on canals.

The walking of cattle in drained lands was found to form numerous paths on the borders of canals and trenches which may become so deep, if the peat is wet, that the ridge between the path and the channel rolls off into the channel. Apparently no harm was caused to canals in relatively dry swamps.

On level ground vegetation was found to be a very obstructive agency, especially in peat soils, while in clay, silt, and sand soils and in woody fens vegetation was found to consolidate the sides of canals.

With reference to the effect of age, it was found that of the phenomena affecting the condition of canals, those resulting from displacement of earth occur as a rule only within two or three years after excavation. The phenomena caused by the motion of water were found to persist longer and to be intense immediately after excavation, but to decrease gradually with years and at last cease. Freezing was found to be persistent, but its action weakened after the second year owing to vegetation. The effect of vegetation was found to increase with the years and eventually to block channels completely.

**Are Microscopic Animals a Factor in the Foaming of Imhoff Tanks?** J. B. Lackey (Public Works, 56 (1925), No. 1, pp. 6, 7, figs. 2).—Studies conducted at the New Jersey Experiment Stations are briefly reported, the results of which are said to show that when a tank is functioning well there are but few protozoa in it, but when a tank foams the numbers have been known to increase to 250,000 small flagellates and 20,000 small ciliates per cubic centimeter. Most of these protozoa have been found to attack the sewage directly or to live on material released in the processes of decomposition. Very few of them subsist on the bacteria which are present.

A comparison by sizes and numbers of protozoa and bacteria shows that the protozoa in a cubic centimeter are comparable to 122,000,000 bacteria, and in a tank which was foaming the numbers of bacteria per cubic centimeter were shown to vary from 4,000,000 to 300,000,000. This is taken to indicate that the protozoa may more than equal the bacteria when the volumes of the two are compared.

**Road Engineering,** E. L. Leeming (London and Bombay: Constable & Co., Ltd., 1924, pp. XIII—279, pls. 2, figs. 125).—This is one of the Glasgow Text Books of Civil Engineering, edited by G. Moncur. The purpose of this book is to give in concise form the technology of road construction as viewed in the light of new conditions created by modern traffic, with special reference to British conditions. It contains chapters on subsoils and drainage; bridges, culverts, and retaining walls; camber and its effects; curves; superelevations on highway curves; the design and improvement of hill roads; census of traffic and its relation to road widths; sett-paved roads; water-bound macadam; bituminous and tarred roads; concrete roads; reinforced concrete; sidewalks; road corrugation; measurement of wear; the influence of tires; speed, and vehicle design upon road surfaces; underground work and reinstatement of paving; labor saving machinery; and organization and administration. Three appendixes are included, viz., British standard nomenclature of tars, pitches, bitumens, and asphalts when used for road purposes; road direction posts and warning signs; and road legislation.

**Plowing and Cultural Tests [at the Utah Station],** A. F. Bracken (Utah Station Bul. 192 (1925), p. 21).—It has been found that either fall plowing or plowing done in early spring to a depth of 8 inches, followed by enough tillage to keep weed growth down and prepare a good seedbed is sufficient. Deep plowing, very frequent tillage of fallow, double plowing, and disking preceding plowing are said to be unnecessary.

A test of the time of spring plowing indicates that all spring plowing should be done within a period of two weeks after the season for plowing starts, and that the land which can not be turned in this period should be fall plowed.

**Application of Electricity to Agricultural Apparatus.** [trans. title], Moussett (Bulletin Soc. Franc. Elect., 4, ser., 4 (1924), No. 36, pp. 515-531, abs. in Sci. Abs., Sect. B—Elect. Engin., 27 (1924), No. 324, p. 564).—A general review is made of the field of the application of electricity to farming operations in Europe, with particular reference to the operation of the various mechanical appliances commonly used. In this connection a classified list of apparatus is given with the approximate power requirement in each case. The method of use and the location of the various motors required is discussed, and attention is drawn to the advantage of portable motors. Methods of promoting the agricultural use of electricity are also outlined.

**The Insulation of Roofs to Prevent Heat Loss and Condensation,** W. L. Miller (Heating and Ventilating Magazine, 22 (1925), No. 1, pp. 49-51, 67, fig. 1.)—Data are presented on the subject, together with a chart for figuring in one operation the necessary roof resistance for any humidity to prevent condensation.

**Electric Power for Orchard Spraying,** B. D. Moses and W. P. Duruz (Journal of Electricity, San Francisco 54 (1925), No. 4, pp. 129-131, figs. 6).—In a contribution from the California Experiment Station data on the use of electric power for the spraying of orchards is briefly presented. It is estimated that in the early spring when spraying is most essential at least 75 per cent of the spray rigs in California are in operation. This means a possible load of approximately 22,500 horsepower which, spread throughout the year, would total about 10,000,000 horsepower-hours.

**Fertilizer Spreaders** [trans. title], Leonhards (Ztschr Pflanzenernahr, u. Dungung, 3 (1924), No. 2, Wirtschaft.-Prakt., pp. 461-464).—The author summarizes work by himself and others on the comparative value of broad spread and row fertilization of crops, especially grains, by machines. The conclusion is drawn that for German conditions row fertilization by machines has no advantage over broad spread fertilization.

**Black Soil Under Irrigation with Bore Water,** R. W. McDiarmid (Agricultural Gazette, New South Wales, Sydney, 35 (1924), No. 12, pp. 845-854, figs. 3).—Data on the use of artesian bore water for irrigation purposes in New South Wales are presented. The results showed that irrigation with artesian water is highly successful and, with the exception of the production of crops for marketing, the carrying capacity of the land can be very much increased thereby.

**Reinforced Concrete Design,** G. P. Manning (London and New York: Longmans, Green & Co., 1924, pp. XVI—484, pls. 2, figs. 208.—The purpose of this work is to establish methods for the design of reinforced concrete suitable for use by a practicing engineer. It is divided into three parts.

Part 1 treats of the cross sections of members and the stresses produced and contains chapters on rectangular sections under bending only—no compression steel, rectangular sections under bending only—general case, T-sections under bending only, sections under tension only, sections under compression only, sections under bending and tension combined, sections under bending and compression combined, and sections under shear. Part 2 deals with the question of members as a whole and contains chapters on continuous beams, reinforcement—quantities, footing slabs, rectangular beams, T-beams, ties, columns and struts, square panel slabs, arched members, circular tanks, piles and sheet piles, hopper bottoms, hollow tile floors, flat-slab floors, domes, and staircases. Part 3 is a discussion of complete structures and contains chapters on design of structures—general, buildings, continuous footings, water towers and reservoirs, bunkers and silos, bridges, retaining walls, chimneys, and first principles.

**The Relationship of Air Consumption to Brake Horsepower in Internal Combustion Engines, Road and Flight Tests,** H. Moss (Institute of Mechanical Engineering [London] Proceedings, 1924, I, pp. 345-390, figs. 19).—A description is given of a new air flow meter based on the principle of continuous flow electrical calorimetry. The air consumption is measured by the amount of heat required to raise the temperature of the air through a fixed range of about 1.5 degrees Centigrade (34.7 degrees Fahrenheit). The heat is supplied by a resistance coil in the form of a mat placed across the intake pipe and heated electrically. The rise in temperature is measured by two resistance thermometers in the form of grids, one on each side of the heating coil and connected differentially. The instrument is attached to the air intake of the engine. The heating current is adjusted till the temperature rise is a fixed amount and is then measured by the voltage across the heating coil.

Experiments with two different engines showed that the calibration curve of the air flow meter obtained with steady flow held good for a high-speed engine. A damping air reservoir of small bulk only was needed in extreme cases to produce identity of steady flow and engine flow calibrations for engines of lower speed and fewer cylinders. The data are taken to indicate that a measure of the air consumption should give the brake horsepower with a possible error of less than two per cent.

**Electric Plowing** [trans. title], Guedeney (Bulletin Society of Franc. Elect., 4. ser., 4 (1924), No. 36, pp. 533-545, figs. 4; abs. in Sci. Abs., Sect. B—Electrical Engineering, 27 (1924), No. 324, p. 565).—The advantages of electric plowing over other methods are outlined, and it is stated that one complete outfit of this type with two men can do the work of from fifty to sixty draft animals and from ten to fifteen men. The outfit described consists of a double drum portable winding engine with two ropes and four anchor pulleys, two of which are fixed and two movable. It is stated that an area of approximately forty acres can be plowed from one position of the winding engine.

**Rural Electrification in Pennsylvania,** R. U. Blasingame (Electrical World, 85 (1925), No. 14, pp. 713-715, figs. 5).—A brief statement of the results of field surveys as to the agricultural uses of electricity in the state is presented, together with an analysis of some of the problems involved. It is concluded that before rural electrification can be instituted successfully much research work must be done on such elements as the determination of a satisfactory rate, the improvement of existing farm machinery, the determination of the best ratings and sizes of farm machinery, and ascertaining the proper farming methods for insuring the most uniform use of labor and machinery.

**Investigation is Made of Low Pressure Tires,** T. R. Agg (Iowa Engineer, Ames, 25 (1925), No. 5. p. 8, fig. 1).—Studies conducted at Iowa State College on fuel consumption and its relation to the resistance of balloon tires showed that in general the rolling resistance of low pressure tires is about 8 pounds per ton higher than for the regular high pressure tires, or at a speed of 30 miles per hour is about 20 per cent higher. The increase in gasoline consumption was not in proportion to the increase in rolling resistance. On the average the balloon tire and the balloon type of tire gave about the same results, and both showed an increase in fuel consumption of about 7 per cent over the regular high pressure tires. General observations during about 6,000 miles of operation indicated that the low pressure tires will give satisfactory wear if the vehicle is not driven with the wheels in bad ruts.

**Tapered Struts: A Theoretical and Experimental Investigation,** P. E. Boyd (Ohio State University Engineering Expt. Station Bulletin, Columbus, 25 (1923), pp. 91, figs. 23).—The results of a theoretical and experimental investigation of tapered struts to develop exact formulas for the computation of the strength and deflection of such tapered compression members is presented in considerable detail.

**Farm Drainage Methods (Survey and Design),** 1908-1922, H. B. Roe (Minnesota Station Bulletin 216 (1924), pp. 5-71, figs. 22).—A large amount of engineering information is contained in this bulletin on methods of survey and design of farm drainage systems, which is based on experience at the station from 1908 to 1922 inclusive.

**Electric Washing Machines,** R. M. Kellogg, (N. Y. Agr. Col. (Cornell) Ext. Bul. 102 (1924), pp. 11, figs. 4).—Brief popular information is given on electric washing machines.

**Structural Engineers' Handbook,** M. S. Ketchum (New York and London: McGraw-Hill Book Company, Inc., 1924, 3. ed., enl., pp. XV+1065, figs. 450).—This is the third edition of this handbook of data for the design and construction of steel bridges and buildings. In this edition the book has been revised and partially rewritten and more than 130 pages of new material have been added. The most important additions are chapters on the design of self-supporting steel stacks, constant dimension steel columns, steel column footings, and specifications for structural steel for buildings.

**A Bibliography Relating to Soil Alkalies,** F. V. King, G. Ervin, and O. L. Evans (U. S. Department of Agriculture Bulletin 1314 (1925), pp. 40).—This bibliography was compiled under the direction of S. H. McCrory, with special reference to the deleterious action of soil alkalies and various other chemical agents on cement and concrete. It contains sections on soil alkalinity, alkali soil salts, sea water, other injurious agents, waterproofing of concrete, and alkali-resistant concrete.

**New Data on Radiator Finishes and Their Effect on Heat Transmission,** W. H. Severns (Heating and Ventilating Magazine, 22 (1925), No. 2, pp. 51-53, figs. 2).—Studies conducted at the University of Illinois are briefly reported, the results of which are taken to indicate that the application of aluminum bronze to the surfaces of radiators ordinarily used in direct steam heating will not cause a reduction of 26 or even 18 per cent in the amount of heat transmitted by the surfaces, as has been found by others. These percentages are said to be too large and a reduction of 10 per cent in the amount of transmitted heat is considered to be more nearly correct. This means that from 10 to 11 per cent more square feet of direct radiation covered with aluminum bronze are necessary to supply a given heat loss than would be necessary if clean radiators, either fresh from the foundry or dipped in gray paint, were used without aluminum bronze.

**Structural Engineering: Fundamental Properties of Materials,** G. F. Swain (New York and London: McGraw-Hill Book Co., Inc., 1924, pp. VII+200, figs. 49).—This book deals with the fundamental properties of the principal materials which should be familiar to the engineer. It contains chapters on wood; the constitution, heat treatment, and mechanical treatment of iron and steel; cast iron; wrought iron; malleable cast iron; steel; alloy steels; nonferrous metals and alloys; stone; brick and other clay products; calcareous cement and concrete; and corrosion of metals —paints and varnishes.

**Static Load Tests on Pavement Slabs, J. T. Thompson** (U. S. Department of Agriculture, Public Roads, 5 (1924), No. 9, pp. 1-6, figs. 13).—The results of tests of one hundred and twenty-four pavement slabs to determine the influence of static loads are reported.

The results showed that the static resistance of both the corners and the edges of rigid slabs is affected by the nature of the subgrade, the more resistant the subgrade being to load the greater being the resistance of the slab, and vice versa.

The resistance of rigid slabs to static loads did not vary with the square of the depth but as some power greater than 1 and less than 2, the average value being about 1.75, and being higher for slabs on wet subgrades and lower for those on dry subgrades. The corners and edges of concrete slabs offered about the same degree of resistance to static loads.

The presence of mesh reinforcement did not increase the load-carrying capacity of concrete slabs but did cause a tendency to hold together and resist complete failure after initial or elastic failure had taken place. The bituminous topping laid on rigid slabs did not increase their resistance to static load. Bituminous slabs showed no slab strength at ordinary summer temperatures.

**The Supporting Value of Soil as Influenced by the Bearing Area,** A. T. Goldbeck and M. J. Bussard (U. S. Department of Agriculture, Public Roads, 5 (1925), No. 11, pp. 1-4, 8, figs. 9).—Studies are reported which showed that when a given unit of load is applied to a soil over various areas, the depth of penetration is directly proportional to the square root of the area over which the load is applied. The general form of the relation expressed mathematically is $p \div P = \sqrt{a} \div A$, in which p and P are the penetrations resulting from the application of a constant unit load to areas a and A.

The above relation was established experimentally and was also developed mathematically on the assumption that for any particular soil the areas under pressure at different depths are confined within lines of like inclination extending from the boundaries of the bearing areas.

**An Analysis of the Weir Coefficient for Suppressed Weirs,** C. W. Harris (Washington [State] University, Engineering Experiment Station Bulletin 22 (1923), pp. 21, figs. 9).—What is considered to be the development of a more rational analysis of the weir coefficient is presented in this bulletin.

**Machines for the Planting and Digging of Potatoes,** C. Santini (Le macchine per piantere e per scavare le patate. Portici: Lab. Mecc. Costruz., R. Scuola Super. Agr., 1924, pp. 79, figs. 39).—A number of different potato planters and diggers are described and illustrated, and service tests are reported.

**The Moisture Equivalent as Influenced by the Amount of Soil Used in its Determination,** F. J. Veihmeyer, O. W. Israelsen, and J. P. Conrad (California Station Technical Paper 16 (1924), pp. 64, pls. 2, figs. 10).—Studies of the influence of the amount of soil used in the determination of the moisture equivalent in five different soils are reported.

The results showed that the amount of soil used materially influences the moisture equivalent, the smaller the sample the larger the percentage of water retained. The difference is greater with small samples than with large ones. Some clay soils were found to become impermeable to water during centrifuging when the amount of soil placed in the centrifuge cup was increased, and these soils reabsorbed the supernatant water when the centrifugal force was relieved.

The moisture content was found to increase from the inner to the outer surface of a 60-gm. block of soil, but the rate of increase was lower than that resulting from reducing the size of sample from 60 to 5 gm. The amount of water retained within blocks of soil much larger than 60 gm. probably increases from the inner surface to the outer surface if the soil is centrifuged long enough to establish equilibrium. The apparent specific gravity of a 60 gm. block of soil was found to be significantly greater than that of a 10-gm. block, and decreased continuously as the size of sample was decreased from 60 to 10 gm. The apparent specific gravity within a 60-gm. sample increased significantly from the inner surface outward to a point about 6 mm. within the sample, beyond which it remained substantially constant to the outer surface.

The placing of weights on the inner surface of 5, 10, 20, or 30-gm. samples decreased the amount of water retained by the soil. Subjecting the moist soil to centrifugal force until the moisture was in equilibrium with this force resulted in the establishment of an equipotential region throughout the block of soil. In general, it was found that the average pore space does not limit the amount of water retained by the soil block, and it is considered probable that the outer layer of the fine textured soils is saturated or nearly so.

When precision is desired, it is considered necessary to measure the sample by weight rather than by the measuring cup. The variation in moisture equivalent with samples of different sizes was found to be influenced by the degree of compactness as well as by the depth of the sample in the centrifuge cup. The results as a whole are taken to indicate that further standardization of the moisture equivalent method is necessary if comparable results are to be obtained.

**Studies on the Biology of Sewage Disposal,** W. Rudolfs et al, (New Jersey Station Bulletin 403 (1924), pp. 3-95, figs. 39).—This is the third annual report of the joint project on the subject of the stations and the New Jersey State Department of Health. Separate studies have also been reported from time to time.

Studies by F. L. Campbell and Rudolfs on operating and resting Imhoff tanks showed that practically all observations and determinations made on the resting and operating tanks pointed to a rise and then a fall in sludge digestive activity during the course of the tests. High amounts of ammonia were found to correspond with a low percentage of carbon dioxide production except in the cases during and shortly after sludge drawing, when the ammonia produced had not yet had a chance to accumulate. The carbonates reached the highest peaks shortly after those for carbon dioxide and ammonia. The total acidity did not coincide with the greatest carbon dioxide production. A comparison of pH values with carbon dioxide content showed in general an inverse relation. Apparently H-ion concentration gives a true index of the total activities taking place in the tank. Foaming phenomena occurred when the pH values of the liquid between the scum and sludge were below 7 and foaming subsided when the H-ion concentration was above the neutral point.

Bacteriological investigations by M. Hotchkiss on operating and resting Imhoff tanks apparently established the fact that in these tanks there is an inverse relationship between the numbers of albumin digesting and hydrogen sulfide producing bacteria. This is taken to indicate that different types of digestion dominate at different times.

Studies of the fauna of Imhoff tanks and sprinkling beds by J. B. Lackey indicated the probability that the protozoa of Imhoff tanks afford a fair criterion as to the proper working conditions therein. When the tanks foam or seem to digest poorly the number of protozoa is high, and when there is but little solid matter in the liquid the number tends to be small. It is considered questionable if their numbers are ever large enough to affect the bacteria in the tanks, the reverse being more likely. It was found that the number of genera of protozoa in filter beds which occur with some regularity in numbers over 5,000 per cubic centimeter is small.

Studies by Rudolfs, Campbell, Hotchkiss, and Lackey on the digestion of fresh solids showed that a relation apparently exists between the total bacteria, total animal life, percentage of carbon dioxide of the gas, and the pH values obtained. Bacteria producing carbon dioxide influenced the changes of the pH index. A fluctuation in bacteria seemed to be correlated with a fluctuation of microscopic animals. A rise and fall of H-ion concentration occurred with the rise and fall of carbon dioxide. The relation between chemical end products other than carbon dioxide, and bacteria was not directly apparent. Fresh solids seemed to behave very similarly whether mixed with partially digested material or collected directly. Material digesting in an operating or resting tank seemed to follow in general the same course of digestion as fresh unseeded or contaminated solids.

Decomposing fresh material became acid and had a tendency to remain so for some time until the decomposition progressed far enough to produce alkaline products. When the liquid in the tanks registered a pH below 7 the solids rose and foaming resulted, while when the H-ion concentration was slightly above the neutral point foaming subsided and the scum receded.

Studies by Rudolfs and H. A. Trajkovich on fungi and algae of the sprinkling filter bed and their distribution indicated a seasonal fluctuation of fungi, reaching a maximum during the winter months.

Experiments on the physiology of fungus No. 2 (Penicillium) by Rudolfs and Trajkovich indicated that this organism was unable to live and reproduce in the absence of air, to produce ammonia, to decompose cellulose, or to liquefy gelatin.

A comparison by Rudolfs and Lackey of the digestion of fresh solids and fresh solids contaminated with partially digested material showed that the latter went through a course of digestion similar to the former, there being, however, a marked difference in the rapidity of digestion. Shortly after the contaminated fresh solids were collected the animal population decreased materially. After some time they multiplied enormously, and this increase was again succeeded by a more sparse animal population. The first stage coincided with the lowering of pH values, while the second occurred when no rapid changes were taking place in the H-ion concentration, but while it was rising slowly above the neutral point.

Film removal studies by Rudolfs showed that when this process started within the filter bed, several species of protozoa increased rapidly in numbers, there being apparently a succession of groups. After some time when debris accumulated and fungi became more abundant, the large numbers of free swimming protozoa disappeared. The total growth fluctuated considerably during the year, but a steady increase of film took place until its accumulation resulted in a new slough.

**Comparisons of the Strength of Concrete in Tension and Compression,** N. M. Finkbiner (U. S. Department of Agriculture, Public Roads, 5 (1925), No. 11, pp. 14).—Studies conducted by the Oregon State Highway Commission are briefly reported, indicating that under general field conditions in Oregon the compressive strength of concrete in pounds per square inch divided by 10 will give approximately the strength of the concrete in tension at the age of 28 days.

**A Preliminary Investigation into the Draft of the Plow,** W. M. Davies (Journal of Agricultural Science [England], 14 (1924), No. 3, pp. 370-406, figs. 16).—In a contribution from the School of Agriculture, Cambridge, detailed studies on the soil factors influencing the draft of a plow are reported.

The results showed that the state of consolidation resulting from the nature and treatment of the previous crop has a most marked influence on the draft, causing variations of from 107 to 580 pounds in gross draft and of from 68 to 483 pounds in net draft on a typical two-horse soil, when the force exerted by each horse is about 150 pounds.

The relation between draft and depth of furrow was found to be linear, the net draft per square inch tending to increase in value with increasing depth, except when the previous crop was a root crop, when a decrease at depths greater than from 6 to 8 inches was noticeable. The relation between draft and width of furrow was also linear, the net draft per square inch in some cases showing an increase and in others a decrease with increasing width. Further observations suggested that a greater proportion of the net draft is used in overcoming the resistance of the soil than in turning the furrow.

The quantity of moisture in the soil had a considerable effect on draft. It is thought probable that there is an optimum content from which an increase or a decrease will result in increased draft. In one case measured, a decrease in soil moisture of 6 per cent resulted in an increase in draft of 28 per cent.

The double plow was found to be a more efficient implement than the single plow with similar fittings and moldboard.

**Applied Elasticity,** J. Prescott (London and New York: Longmans, Green & Co., 1924, pp. VII—666, figs. 184).—The purpose of this book is to deal with the subject of applied elasticity from the point of view of the engineer. It contains chapters on analysis of stress; relations between stress and strain; some particular solutions of the equations of equilibrium; the empirical basis of elasticity; the bending of thin rods by transverse forces; thin rods under tension or thrust; torsion of rods, Saint Venant's theory; the energy in a strained body; transverse oscillations of thin rods; longitudinal and torsional oscillations of rods; the equilibrium of thin curved rods, spheres and cylinders; stretching of thin plates; bending of thin plates under normal pressures; the bending of thin plates, more accurate theory; stability of thin plates; cylinders with thin walls; vibrations of rotating disks; elastic bodies in contact. Three appendixes are included.

**[Irrigation Experiments at the Utah Station],** D. W. Pittman and G. Stewart (Utah Station Bulletin, 192 (1925), p. 24).—It is stated that in the course of irrigation experiments it has been definitely established that the heavier the irrigation treatment the more rapid is the exhaustion of the soil.

# News Section

## Agricultural Engineers Meet at Madison

THE annual meetings of the American Society of Agricultural Engineers are milestones in the growth of the organization and the advancement of the profession of agricultural engineering. In this highly specialized, rapidly growing field of engineering the annual meetings of the Society serve to mark the progress that is being made. These events are a revelation to those in attendance because development, even in so short a period as a year, is more rapid than one has anticipated.

The annual meeting of the Society was held this year at Madison, Wisconsin, June 22, 23, 24, and 25, the place where it was founded nearly nineteen years ago. Comparing the Society and the profession now and when it was founded in December 1907, and also in view of the fact that at that time agricultural engineering as a profession was practically unknown and unnamed, the progress that has been made is remarkable, to say the least.

A significant thing about the annual meetings of the Society is the large percentage of members who attend. At the Madison meeting last month practically twenty-five per cent of the entire membership of the Society was in attendance. The attendance this year numbered nearly two hundred, which is by far the largest attendance at any annual meeting in the history of the organization.

The first day of the meeting, June 22, was devoted to inspection trips and demonstrations on the University Farm conducted by members of the agricultural-engineering staff of the University of Wisconsin. This included a horse-pulling contest, demonstration of a belt dynamometer on a silo filler, inspection of the drainage system at the University Marsh, demonstration of rock blasting by two different methods, and marsh plowing with a special plow.

Seventy-five of those in attendance at the meeting enjoyed a delightful boat trip on Lake Mendota as the guests of Bascom B. Clarke, a charter member and also an honorary member of the Society.

In the evening the heads of departments of agricultural engineering at the land-grant colleges held a dinner and conference on questions of mutual interest. An outstanding feature of this meeting was the harmony and oneness of purpose which seemed apparent throughout the entire session, which lasted until late in the evening. Twenty-six states were represented by department heads or those in charge of agricultural engineering at these institutions.

The second day of the meeting, June 23, was devoted to all-day programs presented simultaneously by the three technical divisions: Farm Power and Machinery, Reclamation, and Farm Structures. These were presided over by the three respective division chairmen: F. A. Wirt, John Swenehart, and W. A. Foster. All three divisions had an attendance nearly double that of any previous meetings of these divisions.

At 6 P. M. of the second day the men engaged in extension in agricultural engineering at the land grant colleges held an informal dinner and round-table discussions of questions of mutual interest.

The regular annual business meeting of the Society was held on the evening of June 23. President Walker presided at the meeting, which opened with the reading and approval of the minutes of the business meeting held at Lincoln, Nebraska, June 1924.

The meeting was chiefly devoted to the reading and acceptance of reports which included the report of the secretary-treasurer, Raymond Olney; report of the Committee on Agricultural Engineering Data, F. P. Hanson, chairman; report of the Society's representatives on American Engineering Council, H. B. Walker; report of the Committee on the Relation of Electricity to Agriculture, J. B. Davidson; report of the Publication Committee, S. H. McCrory, chairman; and also reports from the Pacific Coast and North Atlantic Sections.

At the business meeting it was announced that the Council had voted definitely to hold the 1926 annual meeting of the Society at Lake Tahoe, California, June 23, 24, 25, and 26. L. J. Fletcher, secretary-treasurer of the Pacific Coast Section and chairman of the Meetings Committee for the ensuing year, explained in considerable detail the plans that have been in progress the past year for the meeting on the Pacific Coast, and incidentally aroused great enthusiasm for the California meeting.

The program of the third day, June 24, was a general program featuring addresses by prominent speakers of interest to all agricultural engineers. The meeting was opened by the president's annual address, delivered by President H. B. Walker, of the Kansas State Agricultural College, which is printed elsewhere in this issue.

Raphael Zon, director of the Lake States Forest Experiment Station of the U. S. Department of Agriculture, addressed the morning session on the subject "Engineering Aspects of Some Forestry Problems." This was followed by an address, entitled "Relation of the Agricultural Engineer to Land Economics," which was prepared jointly by Dr. R. T. Ely and Prof. George S. Wehrwein, of the Institute for Research in Land Economics and Public Utilities, and delivered by Prof. Wehrwein.

H. L. Russell, dean of agriculture of the University of Wisconsin, who, incidentally, welcomed the first meeting of agricultural engineers at Madison, Wisconsin, in December 1907, addressed the meeting on his observations of New Zealand agriculture.

The morning session was concluded with a memorial service for the late Prof. F. W. Ives and J. B. Bartholomew.

The afternoon session of June 24 was addressed by Prof. Dan Scoates, of Texas A. & M. College, on his observations of agricultural-engineering development in Europe. Finley P. Mount, president of the National Association of Farm Equipment Manufacturers and president of the Advance-Rumely Company, delivered an address on "The Agricultural Engineer and the Farm Equipment Industry." The annual report of the Research Committee was presented by R. W. Trullinger, chairman. Arthur Huntington, of the Iowa Railway & Light Company, delivered an address, entitled "Some Problems in Rural Electrification." An interesting address, "An European's Viewpoint on Agricultural Engineering Developments in America," was made by Dr. George Kuehne, professor of agricultural machinery at the Munich Technical Academy, Germany.

The fourth day of the meeting, June 25, was devoted entirely to program of the College Division, a particular feature of which was the paper, entitled "Redirection of Teaching Procedure in the Light of Modern Psychology," by Prof. H. W. Nisonger, of Ohio State University. This was followed by summaries of reports presented by the various chairmen of committees of the College Division.

The afternoon session was devoted to the subject of cooperative relationships which was featured by a paper, entitled "Opportunities and Requirements for Cooperation," by H. B. Walker, of Kansas State Agricultural College. This was followed by discussions on cooperation with the farm-equipment industry, electrical industry, building materials industry, and cooperative education and research.

### Resolutions

WHEREAS, the American Society of Agricultural Engineers is assembled for their nineteenth annual meeting at Madison, Wisconsin, and

WHEREAS, the facilities of the Department of Agricultural Engineering, the College of Agriculture, and the University have been at the disposal of the Society, and

WHEREAS, the Committee on Local Arrangements has done everything in its power to make the meeting a pleasant and profitable one,

THEREFORE, BE IT RESOLVED that this Society, in convention assembled, express its sincere thanks and appreciation to the University of Wisconsin and the College of Agriculture, and

BE IT FURTHER RESOLVED that we thank the Department of Agricultural Engineering and the Committee on Local Arrangements for their efforts, and

BE IT FURTHER RESOLVED that the Secretary be instructed to formally express this appreciation to these organizations.

* * *

WHEREAS, the work of the headquarters office is so vital to the development of a stronger Society, and

WHEREAS, the Secretary has by untiring effort carried on this work in connection with other duties, and

WHEREAS, the development of "Agricultural Engineering," the journal of the Society, has afforded a medium of news, publication of papers of interest, and exchange of ideas, and at the same time is carrying its full portion of the financial load,

THEREFORE BE IT RESOLVED, that this Society recognizes and commends the work of the Secretary during the past year.

* * *

WHEREAS, the Congress of the United States has enacted into a law the Temple Bill for the completion of topographic maps in the United States, in cooperation with the mapping agencies of the various states,

THEREFORE, BE IT RESOLVED that this Society, through its individual members, be encouraged to promote the cooperation of their state departments with the U. S. Geological Survey for the completion of the topographic map.

* * *

WHEREAS, American Engineering Council is sponsoring a reorganization of government service involving the creation of a Division of Public Works under the Department of the Interior, and

WHEREAS, it is proposed to transfer the Bureau of Public Roads from the Department of Agriculture to the Department of the Interior, and

WHEREAS, the Division of Agricultural Engineering, now in the Bureau of Public Roads, would be transferred by such proposed reorganization from the Department of Agriculture where its major duties are centered,

THEREFORE, BE IT RESOLVED that the American Society of Agricultural Engineers endorses any principles of government reorganization, which makes for greater efficiency, and

BE IT FURTHER RESOLVED that the American Society of Agricultural Engineers instruct its representative on the American Engineering Council to use his efforts to retain the duties of the Division of Agricultural Engineering of the Bureau of Public Roads in the Department of Agriculture.

* * *

WHEREAS, the term "agricultural engineering," after several years of deliberation by this Society in its earlier history, was definitely determined upon as the most comprehensive term to be used as designating our activities and profession, and is now generally recognized as a logical and fitting designation of our profession, and

WHEREAS, the term is in use in a large majority of the land-grant colleges, in the Bureau of Public Roads of the U. S. Department of Agriculture, and American Engineering Council admits the agricultural engineer to an equal standing with the other professional engineering groups, and

WHEREAS, for the purpose of wider recognition, a full understanding of our work, and to avoid a confusion of mind, it is highly desirable that the term "agricultural engineering" be universally used,

THEREFORE, BE IT RESOLVED, that it is the sense of this Society that the term "agricultural engineering" most nearly defines the profession, and

BE IT FURTHER RESOLVED that the term, in so far as possible, should be applied to educational work of college grade, and to commercial and research work of a strictly engineering nature, and

BE IT FURTHER RESOLVED that the Secretary be instructed to send copies of this resolution to the president and deans of the land-grant colleges, to the heads of agricultural engineering departments, and to the U. S. Department of Agriculture, the farm press, and such others as may be interested.

# Necrology

## John Barton Bartholomew

JOHN BARTON BARTHOLOMEW, one of the early members of the American Society of Agricultural Engineers and an Honorary Member of the Society since 1921, passed away at his home in Peoria, Illinois, May 27.

J. B. Bartholomew

For many years Mr. Bartholomew has been one of the more prominent figures in the farm-equipment industry, a man who by force of energy and ability rose from a farmer boy to head one of the largest industries of its class. He entered the employ of the Avery Company at Peoria as a boy nearly fifty years ago. He started out by doing odd jobs about the factory and was promoted successively to service man, salesman, branch house manager, sales manager, vice-president, and finally to president.

Mr. Bartholomew, both as an inventor and as a manufacturer, has rendered valuable service to agriculture, particularly along the lines of agricultural engineering; he has contributed outstanding improvements to farm machinery. He was one of the original inventors of the pneumatic wind stacker and the inventor of the Bartholomew self-feeder. He was an inventor of the old steam-lift plow and a more recent self-lift plow was originally worked out by him. He was the first to use renewable inner cylinder walls and adjustable main bearings for tractors.

He was for years an active member of the Thresher Manufacturers Association, which subsequently became a department of the National Association of Farm Equipment Manufacturers. In 1921 he was elected chairman of the executive committee of that association and in 1922 became its president.

Mr. Bartholomew is survived by his wife and two sons, A. Y. Bartholomew and J. B. Bartholomew, Jr., and two daughters, Mrs. Edyl Gray of Peoria and Mrs. Margaret Blythe of Chicago.

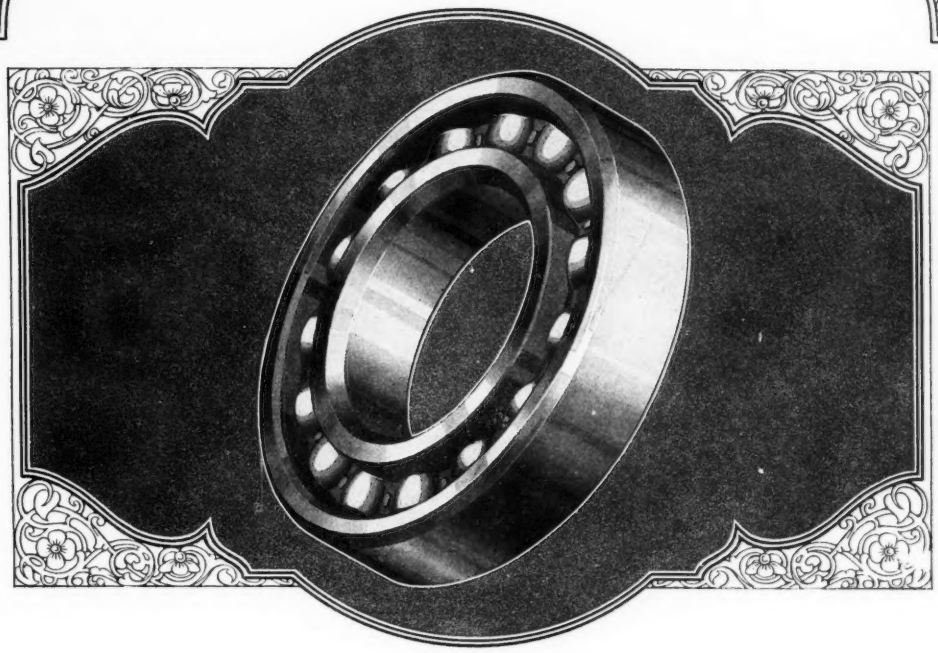
# Personals

**Max E. Cook,** who became associated a year ago with the California Redwood Association and organized an architectural service department at the Los Angeles office, has recently been given the task of organizing and operating an agricultural department at the headquarters of the Association in San Francisco, his time being devoted almost entirely to helping to improve farm buildings, particularly in California.

**George M. Duncomb,** formerly manager of the tractor department of Buchholz Brothers, Ford dealers at Hinsdale, Illinois, has been placed in charge of industrial tractor sales at the Chicago branch of the Ford Motor Company.

**C. V. Englund** has resigned as agricultural engineer for the Portland Cement Association with headquarters at Denver, Colorado, to accept the position of general manager of the Creston Gas & Electric Company, Creston, Iowa.

**L. G. Samsel** has severed his connection with the dairy department of the University of Nebraska to enter the employ of the Chase Plow Company of Lincoln, Nebraska.



# WHY BALL BEARINGS

## *Mean Uninterrupted Performance*

THE farmer's time during a busy season is too valuable to run the chance of having to make any major adjustments in his machinery.

New Departure Ball Bearings may be securely housed to exclude dirt and grit, and since wear is negligible, need never be adjusted.

This point, together with their superior efficiency—permitting the freer flow of power from engine to drawbar—makes New Departure Ball Bearings the logical choice in any tractor or power-driven farm implement.

Ask for the "Special Application Bulletins on Farm Machinery", a technical treatise with much valuable engineering data, to assist you in your design.

THE NEW DEPARTURE MANUFACTURING COMPANY
Detroit Bristol, Connecticut Chicago

# New Departure Ball Bearings

990

## New A. S. A. E. Members

**C. H. B. Chapin,** secretary, Empire State Gas & Electric Association, New York City.

**C. H. Churchill, Jr.,** director of rural activities, Adirondack Power & Light Corporation, Schenectady, N. Y.

**A. T. Upson,** lumber standards advisor, National Lumber Manufacturers Association, Washington, D. C.

## Applicants for Membership

The following is a list of applicants for membership received since the publication of the June issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

**R. C. Agrawal,** lecturer in mechanical engineering, Government Agricultural School, Bulandshahr, U. P., India.

**D. N. Borodin,** president and director, Russian Agricultural Agency in America, Inc., New York City.

**P. M. Churchill,** consulting engineer, Massachusetts Reclamation Board, Elmwood, Mass.

**W. A. Clough,** engineering department, General Electric Company, Chicago, Ill.

**J. D. Eddy,** managing editor, Farm Mechanics Magazine, 1827 Prairie Avenue, Chicago, Ill.

**W. H. Hartman,** Agricultural Engineering Building, University of Wisconsin, Madison, Wis.

**D. G. Miller,** drainage engineer, division of agricultural engineering, U. S. D. A. Bureau of Public Roads, University Farm, St. Paul, Minn.

**B. D. Moses,** assistant professor of agricultural engineering, University of California, University Farm, Davis, Calif.

**R. A. V. Nicholson,** draughtsman, Central Experimental Farm, Ottawa, Canada.

**S. A. Norling,** consulting drainage engineer, Excelsior, Minn.

**F. T. Ransom,** E. I. du Pont de Nemours & Company, Lockport, New York.

**H. A. Wadsworth,** assistant professor, division of irrigation practice, College of Agriculture, Davis, Calif.

**R. W. Wilson,** John Deere Plow Company, McKinney, Texas.

TRANSFER OF GRADE

**H. D. Duckett,** Houston, Texas.

**O. K. Hedden,** farm machinery survey, department of agricultural engineering, University of Nebraska, Shickley, Nebraska.

**V. A. Michael,** Nebraska extension engineer's office, University Place, Nebraska.

## A. S. A. E. Employment Service

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of Agricultural Engineering. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Nonmembers as well as members, are privileged to use the "Positions Available" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

### Men Available

AGRICULTURAL ENGINEER open for position as sales engineer, salesman, advertising writer, or agricultural propagandist. Past experience with large agricultural firms. MA-124.

AGRICULTURAL ENGINEER, 1925 graduate of Kansas State Agricultural College, with farm experience, would like permanent employment at once, preferably with a farm-machinery manufacturer. MA-126.

AGRICULTURAL ENGINEER, graduate of Iowa State College, E. E. 1909, A. E. 1910, desires to make change. Ten years experience in field and factory on tractors, trucks, and farm machinery. Five years teaching experience in agricultural engineering and farm mechanics. Instructional work along agricultural engineering lines preferred. MA-126.

## Directory of Professional Agricultural Engineers

**CLARK E. JACOBY ENGINEERING COMPANY**
**Consulting Engineers**
Drainage, Land Reclamation, River and Flood Control, Tiling, Topographic Surveys, Bridges and Reinforced Concrete Structures
**Interstate Building, Kansas City, Missouri**

**STANLEY F. MORSE**
**Consulting Agricultural Engineer**
Land Examinations, Reports, Development Plans and Estimates. Farm Inspections, Supervision, Management Drainage, Irrigation, Livestock, Fruit Growing, Forestry. Tropical Agriculture. Spanish Spoken.
**MORSE AGRICULTURAL SERVICE**
**133 Front Street, New York City**
Mem. A. S. A. E.

**KURT GRUNWALD**
**Consulting Agricultural Engineer**
Investigations and reports covering crop adaptibility in arid and humid regions, potential sugar beet production, irrigation and drainage problems, appraisals on land, supervision of farms and ranches, and selection of livestock breeds.
**Medford, Long Island, New York**
Mem. A. S. A. E.

**WENDELL P. MILLER**
**Consulting Agricultural Engineer and Architect**
Drainage, Development and Management of Farms, Country Estates and Golf Courses
**247 E. Broad Street, Columbus, Ohio**
Mem. A. S. A. E.

**HARVEY R. BURR**
**Consulting Agricultural Engineer**
Formerly director of agriculture at Williamson Trade School, Pennsylvania
Landscape Gardening—Farm Buildings—Canning Factories
Soils—Livestock—Farm Machinery—Water Power
Marketing—Farm Management
**Waunakee, Dane County, Wisconsin**

**W. K. WINTERHALTER**
**Consulting Agriculturist**
Agricultural Investigations, Reclamation and Development of Farm Lands, Soil Improvement, Irrigation and Drainage, Farm Management. Expert Advice on Location of Beet Sugar Factories, Development of Sugar Beet Districts, and Culture of Sugar Beets and Sugar Beet Seed.
Mem. A. S. A. E.
**2211 Buchanan St., San Francisco, Calif.**

## For Consulting Engineers

AGRICULTURAL engineers, who are doing consulting work or who wish to build up a consulting practice, will derive much benefit from carrying an advertisement in this Directory of Professional Agricultural Engineers.

Rates for professional cards like the above—size 1 by 3½ inches—are as follows:

To A. S. A. E. members: $2.00 per insertion for not less than 12 consecutive insertions; $3.00 per insertion for less than 12 consecutive insertions.

To non-members: $4.00 per insertion for not less than 12 consecutive insertions; $6.00 per insertion for less than 12 consecutive insertions.